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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

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84 LAW AND POLITICAL SCIENCE N.A.
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1380
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 1381
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 1382
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 1383
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 1384
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 1384
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

GENERAL

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

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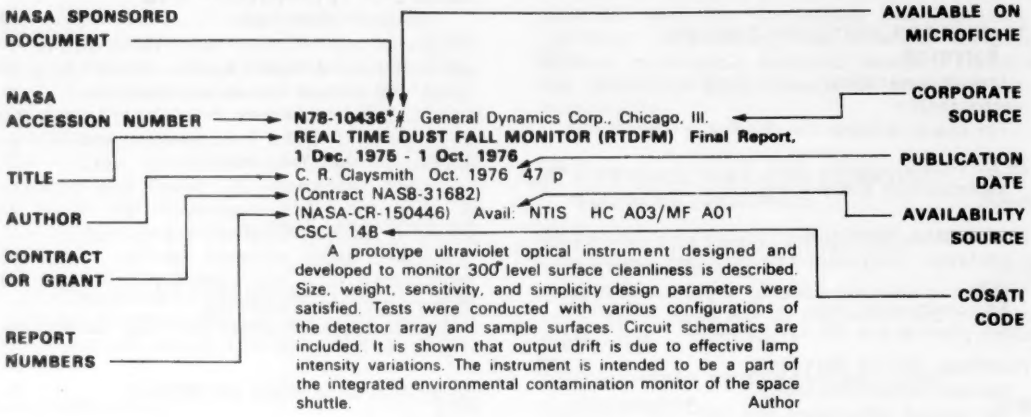
TYPICAL CITATION AND ABSTRACT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NASA ACCESSION NUMBER
N78-10436*# General Dynamics Corp., Chicago, Ill.
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REAL TIME DUST FALL MONITOR (RTDFM) Final Report, 1 Dec. 1975 - 1 Oct. 1976
TITLE
PUBLICATION DATE
C. R. Claysmith Oct. 1976 47 p
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COSATI CODE
A prototype ultraviolet optical instrument designed and developed to monitor 300° level surface cleanliness is described. Size, weight, sensitivity, and simplicity design parameters were satisfied. Tests were conducted with various configurations of the detector array and sample surfaces. Circuit schematics are included. It is shown that output drift is due to effective lamp intensity variations. The instrument is intended to be a part of the integrated environmental contamination monitor of the space shuttle.
Author
REPORT NUMBERS

ON-GOING RESEARCH PROJECTS

This is a listing of research projects— not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, FULL-GROWTH AUXILIARY POWER SYSTEM
F. SURIANO, Garrett Corporation, *Phoenix, Arizona* 85034 (DF451280; F33615-75-C-2016)

The program objective is to develop advanced technology components for the auxiliary power unit (APU) resulting from contracts F33615-69-C-1100 and F33615-72-C-1936. As a goal, these components shall make possible an APU capable of 165 shaft horsepower, 150 hp/ft3, and 1.65 hp/lb at 130 degrees F sea-level static conditions. The program shall emphasize APU hot end component development.

The intent of this effort encompasses APU redesign, utilizing the basic APU configuration developed under contract F33615-72-C-1936 as the baseline, including hot end components development, as required to accomplish the stated objectives. To minimize program cost, a demonstrator APU shall not be developed. The program shall consist of the following two phases: (1) APU design - provide an APU conceptual design, design in detail hot end components to be developed, and define a detailed test plan and (2) component development - develop APU hot end components required to achieve program goals. During conceptual design, the baseline compressor is considered to be that configuration developed under contract F33615-72-C-1936. Adjustments of compressor mass flow and pressure ratio, attainable by minor changes in parameters such as speed, inlet guide vane (IGV) settings, or shroud contour of the baseline compressor stages, are permitted to achieve overall program goals. A critical design review shall be held at design phase completion.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0002, STUDY FOR SYSTEM ANALYSIS TO DEVELOP FUTURE CIVIL AIRCRAFT NOISE REDUCTION ALTERNATIVES
UNKNOWN, Wyle Laboratories Incorporated, *El Segundo, California* 90245 (FA77WA-3990; FA160340 (TRAIS NO.))

The contractor shall develop civil aircraft classification specifications which consider the details of aircraft design, noise characteristics and performance to provide separately identifiable classes for noise regulations. For administrative and regulatory practicability reasons, the key result of this shall be the identification of the minimum practical number of classes which meets all requirements.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0003, CONTRIBUTIONS OF SURFACE CATALYSIS AND GAS PHASE KINETICS TO CATALYTIC COMBUSTOR PERFORMANCE
H. WISE, S R I International, *Menlo Park, California* 94025 (DF049840; F49620-77-C-0123)

AF function - advanced air-breathing engines, airborne weapon delivery, and defense. Deficiency - stable, efficient operating range of catalytic monolith combustors is limited by blow-off at high power, extinction at idle. Objective - assess the relative contributions of surface catalysis and gas phase reaction to catalytic combustor performance under various conditions of preheat, fuel-air ratio, and throughput. How work contributes - results will provide additional understanding and realistic analytical modeling of turbulent reactive flow fields associated with high-temperature catalytic combustion not now available, contribute to overcoming present difficulties and assist in optimizing catalyst kinetic properties, catalyst geometry in monolith, and flow parameters for extending the operating range and in improving the stability and efficiency of jet engine catalytic combustors.

Theoretical and experimental studies will be carried out of basic physical and chemical processes of catalytic combustion. The relative contributions of surface catalysis and gas phase reaction in a catalytic combustor will be assessed by developing a detailed computational model for the distributions of velocity, heat and mass (admixed species) in the reactive turbulent flow through a catalytic duct. Measurements will be made of unknown model input parameters. In particular, experimental determinations will be made of the overall global chemical kinetics for catalyzed and gas-phase oxidation of such fuels as propane and JP-4 in air at fuel-lean equivalence ratios over the range of operating temperatures. Verification that the model correctly describes the turbulent transport and its effects on the distribution of reaction will be made in readily observed stagnation point and boundary layer flows over a flat plate, a test section of the plate acting as a sink, instrumented to measure heat transfer to the wall, or as a source, heated externally or by catalyzed reaction for flow probe measurements. The model will then be simplified by identifying local overall kinetic and transport parameters and be applied to identify optimal catalyst location and chemical parameters for stable and efficient duct and monolith combustion.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0004, TECHNICAL ASSISTANCE FOR THE DEVELOPMENT AND EVALUATION OF AIRBORNE VLF NAVIGATION SYSTEMS
UNKNOWN, Systems Control Incorporated, *Palo Alto, California* 94306 (FA58654; FA75WA-3662)

Tasks include: 1) Preparation of Engineering Requirements 2) Development and Evaluation of Noise Cancellation Antenna System 3) Evaluation of 3.4 kHz Omega Airborne Receiver 4) Development and Evaluation of Civil Omega/VLF Airborne System 5) Development and Evaluation of Operation Type Differential Omega System 6) Low Cost VLF Airborne Systems Evaluations 7) VLF Navigation System Study 8) Definitive Analysis of the Role of VLF Navigation in Aviation.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0005, OPTICAL SYSTEM FOR DYNAMIC ANALYSIS OF ROTATING STRUCTURES
K. STETSON, United Technologies Corp., *Hartford, Connecticut* 06108 (DF457560; F33615-75-C-2013)

The objective of this program is the development and laboratory application of an optical system for performing strain and displacement measurements on rotating structures such as blades and disks. The basis for the optical system is a rotating erector prism which provides continuous motion compensation with respect to the rotating object. Upon development the contractor will use the system to investigate holographic interferometry, speckle photography, and moire interferometry analysis of a rotating blade-disk assembly. The data obtained using these optical techniques will be compared to strain gage results to check both its degree of accuracy and repeatability. Upon demonstrating feasibility and utility of the optical system, a short preliminary study will be carried out to address the problems involved in transitioning the laboratory prototype system to an actual spin pit or test stand optical measurement system.

The overall objective of the program is to develop an optical system for investigating the application of holographic interferometry, speckle photography and moire interferometry for performing dynamic measurements on rotating structures. The program is divided into four phases over a 20-month period including reporting time. Phase I - design study, phase II - erector system development, phase III - applications of systems to rotating objects, and phase IV - problems related to spin pit/engine test stand application.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0006, V/STOL ROTARY PROPULSORS PREDICTION MODEL UPDATE AND EVALUATION
UNKNOWN, United Technologies Corp., *Hartford, Connecticut* 06108 (FA77WA-4067; FA160433 (TRAIS NO.))

A thorough and systematic comparison shall be made between high-quality test data and the levels and spectra predicted by the model. The results shall be carefully analyzed to confirm the accuracy of the prediction procedures and establish areas where improvements are required. All portions of the program shall be exercised.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0007, EXPERIMENTAL INVESTIGATION OF COMPRESSOR ROTOR WAKES
R.P. DRING, United Technologies Corp., *Norwalk, Connecticut* 06856 (DF461860; F33615-77-C-2083)

The objective of this effort is to obtain experimental data which would improve the modeling of secondary flows incorporated in current through-flow axial compressor design systems.

Obtain accurate, detailed circumferential radial, and axial distributions of total and static pressure and the three components of the flow velocity downstream of a rotating axial compressor rotor.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0008, NOISE SUPPRESSION IN JET INLETS
B.T. ZINN, Georgia Inst. of Technology, School of Engineering, *Atlanta, Georgia* 30332 (DF047490; F49620-77-C-0066)

AF function - improved aerospace vehicles. Opportunity - reduce noise levels produced by air-breathing engine-inlet configurations. Objective - develop and experimentally verify an analytical technique for predicting the far-field radiated noise taking variable noise source characteristics, duct absorption properties and inlet geometries into consideration. How work contributes - a better understanding of the coupling mechanisms of the noise generated in the engine inlet ducting (fans and compressor noise) with the far-field radiated noise is required. Also, methods for evaluating the effects of various duct wall acoustic treatments and engine-inlet configurations are needed. Full success of this effort will allow the accurate prediction of the far-field noise levels of an engine inlet and changes to this level due to inlet duct treatment or inlet geometry without the costly cut and dry full-scale testing required at present.

An integral formulation of the Helmholtz equation will be developed, discretized and solved numerically. This formulation will couple the sound source with the radiated far field and will account for changes in the far field due to inlet geometry and wall acoustic liner treatments. Experimental data will be obtained of the radiated sound field from several simple inlet configurations to evaluate the theoretical predictions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0009, FATIGUE CRACK INITIATION AND PROPAGATION OF MEMBERS SUBJECT TO VARIABLE LOADINGS
J. MORROW, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DF139460; AF-AFOSR-3195-77)

The determination of the economic life of aircraft structures exposed to service load histories depends on the development and verification of new techniques and fatigue analysis methods. The main objective of the proposed work is to utilize analysis capability derived from fatigue initiation models to improve crack growth modeling. These initiation models will be used in conjunction with stress/strain determination methods to establish a 'non-arbitrary initial fatigue crack size.' The return on this investment will be an improved structural life prediction capability that has the potential for implementing the economic life determination requirements of MIL-STD-1530A and MIL-SPEC-8866b.

To evaluate the concept of 'non-arbitrary initial fatigue crack size,' careful cyclic elastic-plastic finite-element analyses will be conducted to define the stress strain levels and gradients for three separate notch geometries. The analytical loadings will be limited to a single overload type cycle followed by constant amplitude loadings. Fatigue crack initiation damage accumulation methods will be used in conjunction with the stress-strain results to determine the rate of change of damage with distance below the notch root. Crack propagation damage accumulation analyses will be used in conjunction with appropriate stress intensity factor relationships (that handle geometry and notch residual stress state) to determine the rate of change of damage as a function of crack length. The minimum level of the sum of the two damage rates occurs at the 'non-arbitrary initial fatigue crack size.' The analytical results will be verified by tests conducted after the results establish both the trend and magnitude of the 'non-arbitrary initial fatigue crack size' as a function of notch geometry and crack size.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0010, EXTERNAL AERODYNAMICS
S.A. MASLEN, Martin Marietta Corporation, *Baltimore, Maryland* 21227 (DF036340; F44620-73-C-0041)

AF function - aerospace vehicles. Deficiency - present methods of computing aircraft response to random gust fields are not accurate enough for use in the AFFDL FLEXSTAB program, a computer code used in the design, development and evaluation of aerospace vehicles. Objective - to provide a fundamental input to the AFFDL FLEXSTAB program. How work contributes - this research will put on a more rigorous basis the analysis of flow fields about lifting bodies and surfaces, a prerequisite for the needed development of the detailed understanding of the physical processes by which flexible lifting bodies and surfaces interact with the flow and/or interfere with the flow about other elements of an aerospace vehicle.

By using both analytical and numerical techniques the nature of exact solutions and their singularities will be explored in conjunction with their applicability to numerical solutions of the random gust response problem. New methods which can be used for accurate and convenient engineering analysis will be developed as necessary. Specifically, the asymptotic limit behavior of gust response functions for any type of gust and aircraft wing (including aspect ratio) will be studied with the objective of providing realistic recommendations to the AFFDL for improvement of the unsteady aerodynamic aspects of the FLEXSTAB program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0011, MANUAL ENTRY AND DISPLAY (MED) FOR CLARKSBURG
J.D. NILSEN, U.S. Dept. of Commerce, Equipment Development Lab., *Silver Spring, Maryland* 20910 (RAA231)

TECHNICAL OBJECTIVE: To develop a manual entry and display (MED) with an additional display to be operated remotely in the sunlit environment of a tower. Interface the system with the AMOS III-70 presently installed at the Clarksburg, West Virginia, tower.

APPROACH: Expand AMOS MED to provide additional required functions including designing new circuitry to interface the bright display and the printer.

PROGRESS: Progress is reported under the Surface Sensor Development Task (No. 8AA8102), Surface Observing Systems Project.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin., Systems Research & Development Service

1.0012, HELICOPTER ROTOR NOISE STUDIES 12931-EX
W.L. HARRIS, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DA0E9066; DAAG29 76 C 0027)

To conduct experiments to identify and quantify the mechanisms of rotor noise generation at low subsonic tip Mach number, to obtain the characteristics of the resulting acoustic field and to evaluate and varify experimentally a Mach number scaling formula for rotational noise at low tip speeds. This research is directly relevant and contributory to the research investigations on helicopter rotor noise at both the Langley and Ames Directorates of AMRDL. The proposed investigations cover a flight regime for which there are no facilities at AMRDL and would, therefore, be highly useful in any comprehensive helicopter noise reduction program.

A unique experimental facility consisting of an open jet test section in an anechoic room will be utilized to determine the effects of blade number, advance ratio, thrust and rotor disk tilt angle on rotational noise and blade slap.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

1.0013, PHASE DERIVED NAVIGATION
H.C. SALWEN, Proteon Associates Inc., *Waltham, Massachusetts* 02154 (DF900290; F19628-76-C-0040)

AF function - aircraft landing aids. Deficiency - in addition to the present transition from instrument landing system (ILS) to microwave landing system (MLS) techniques a requirement exists for an independent landing monitor system (LMS) to check on the primary system and to serve as a confidence builder for the pilot landing in adverse weather. Objective - to develop and investigate basic components of an aircraft perspective system. How research contributes - an experimental three-beacon transmitter two-receiver system is designed and integrated with a computer/graphic display to generate CRT perspective presentations of the multiple transmitter positions based on incremental range and phase difference data. Special emphasis is placed on multipath interference suppression.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

1.0014, EJECTION SEAT TWO-AXIS FLUIDIC THRUST VECTORING SYSTEM
R.B. BEALE, Honeywell Incorporated, *Minneapolis, Minnesota* 55413 (DF136860; F33615-76-C-3070)

Aerodynamic and/or rocket thrust line - center of gravity misalignment can result in ejection seat instability leading to reduced trajectory height, unacceptable loads on the crewmember, and possible recovery parachute entanglement. The objective of this effort is to experimentally validate a selected fluidic thrust vectoring system concept which will be identified by a current AFFDL effort. A system which increases the stability of the ejection seat during the critical rocket burn portion of the trajectory will result in lower major injury and fatality rates for USAF ejection seat escape systems.

The preliminary design of a two-axis fluidic thrust vectoring system which will result from a current AFFDL effort will be utilized as the starting point of this effort. Experimental validation of the fluidic/mechanical components as well as the complete subsystem will be performed utilizing conventional cold gas techniques. An analytical performance evaluation of a fluidically stabilized ejection seat will be conducted concurrently with the experimental validation effort.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0015, PREDICTION OF BUFFET RESPONSE OF 1/6 SCALE MODELS OF F-111 TACT WINGS
D.L. CRONIN, Univ. of Missouri, School of Engineering, *Rolla, Missouri* 65401 (NCA 2-450801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0016, HIGH-SPEED INLET INVESTIGATION
D.E. SPONG, McDonnell Douglas Astro. Co., *St. Louis, Missouri* 63166 (DF133970; F33615-75-C-3072)

There currently exists a lack of technology directly applicable to the design and development of advanced air-breathing propulsion systems being considered for advanced high-speed manned aircraft systems. For this class of vehicles, the propulsion system becomes a significant portion of the overall aircraft design and must be considered in the initial stages of the development. The inlet performance can have significant effects on the aircraft range or performance, and if not handled properly the inlet flows could adversely impact the vehicle stability. Proper understanding of the aerodynamic design is required before structural problems can be addressed. The objective of this effort is to develop design criteria and procedures for air induction systems designed for operation in the Mach 3 to 5 speed range.

The approach will be to design inlet systems for both an advanced aircraft system and for an advanced high-speed research system. Following the design and analysis, an experimental program will be conducted to validate or develop the design criteria.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0017, USE OF THE AV-8A'S THRUST VECTORING CAPABILITY
UNKNOWN, McDonnell Douglas Corporation, *St. Louis, Missouri* 63166 (DN590155; N00019-76-C-0285)

The AV-8A is today's only operational vectored thrust aircraft. The objective is to provide empirical data from which a basis can in part be generated for future vectored thrust design criteria.

The contractor will analyze and quantify the operational advantage of the vectoring capabilities of the AV-8A aircraft when applied to air combat maneuvering (ACM) and air-to-ground weapons delivery situations.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

1.0018, RELIABILITY-BASED SCATTER FACTORS
M. SHINOZUKA, Modern Analysis Incorporated, *Ridgewood, New Jersey* (DF139970; F33615-77-C-3055)

There is a requirement to establish design procedures for assessing minimum life of aircraft details at a given reliability value to assure compliance with economical service life and safe life requirements. When either designing experiments or utilizing experimental data to compare or evaluate aircraft details and construction procedures, considering both mean life and scatter is important as both affect the time to first failure. The objective of this effort is the development of procedures for evaluating and the actual evaluation of scatter factors for predicting times to first failure at a given reliability value for a given number of aircraft

details from fatigue data on a given number of specimens tested to similar conditions. The results of this effort will permit designing experiments and comparing results to obtain the proper selection of aircraft details and construction procedures and to estimate in-service performance.

Distributions of times or numbers of cycles to produce fatigue cracks tend to be Weibull. Given the number of details to be considered, time or number of cycles to first cracking can be determined with a given confidence or reliability by estimating the parameters of a Weibull distribution from the test data. The time to first failure is evaluated from the distribution for time to first failure. This distribution is also Weibull and the parameters can be established from the parameters estimated for the distribution of times to fatigue cracking. The influence of scatter in the estimates of these parameters due to the finite number of fatigue tests must be included in the evaluation. The time to first failure at a given reliability value can be determined from a scatter factor by which the estimate for the scale parameter can be divided to obtain this time. During this effort, a procedure for establishing the effects of scatter in the parameter estimation will be developed using Monte Carlo simulation techniques. This procedure and the relationship between parameters of the distribution of times to failure and times to first cracking of a given number of details will be used to evaluate scatter factors for different numbers of tests, details considered and reliability values.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0019, ROTOR BEARING DYNAMICS DESIGN TECHNOLOGY

C.H. PAN, Shaker Research Corporation, *Ballston Lake, New York* 12019 (DF458690; F33615-76-C-2038)

Update current AFAPL-TR-65-45 series to reflect state-of-the-art advanced and to clarify certain sections.

Review current volumes, literature, and practice to establish areas for update, correction, and/or additions. Rewrite and restructure the guides to reflect and improve ease of use. Add volume on gas lubed foils and pneumomechanical critical speed control. Provide for systematic update.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0020, DEVELOPMENT OF AN ACOUSTIC EMISSION SYSTEM FOR DAMAGE MONITORING OF FULL-SCALE METALLIC AIRCRAFT STRUCTURES DURING FATIGUE TESTING

C.R. HORAK, Grumman Corporation, *Bethpage, New York* 11714 (DF138180; F33615-76-C-3073)

To insure that the structures of Air Force flight vehicles are properly designed it is necessary to test full-scale components of the aircraft. Air Force regulation 80-13, 'Aircraft Structural Integrity Program (ASIP),' dated 12 June 69, establishes the requirement for structural testing of all aircraft systems. As the testing procedures increasingly become more thorough and complex, instrumentation to monitor and record the results of such testing must also satisfy increasingly complex requirements. Acoustic emission is one developing technology that should be exploited where applicable. The objective of this work unit is the monitoring of the advanced metallic air vehicle structure (AMAVS) fatigue tests with acoustic emission equipment and an assessment of the results. The results are to be used in the development of an on-line, real-time, damage warning system for laboratory testing of military aircraft structures.

The Grumman acoustic emission system, as utilized in this application, will enable the monitoring of six separate structural areas, including any four areas on a continuous basis. System approach is to eliminate all undesirable noise response caused by loading equipment, faying surfaces, and loose fasteners by means of optimum hardware utilization, so that only usable acoustic emission signals are processed by the system computer codes (software). This is accomplished by use of both master-slave and coincidence spatial discrimination techniques, together with a unique waveform discrimination technique.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0021, INCORPORATION OF ASOP3 INTO FASTOP

J. MARKOWITZ, Grumman Corporation, *Bethpage, New York* 11714 (DF140480; F33615-77-C-3027)

High-performance requirements on modern aircraft make it essential that airframe designs be as light as possible and yet stiff and strong enough to avoid failure. To support the mission of providing accurate design information on complex airframes, computer codes must be developed which efficiently determine minimum weight design data on critical structural components. The increasing use of lightweight composite materials provides great stiffness and strength, but their complex elastic properties cannot yet be adequately handled by the design program. The objective of this present effort is to upgrade the capability of the Air Force's primary stiffness and strength design program, FASTOP, by inclusion of a new composite strength code, ASOP-3. When these programs are fully integrated, aircraft lifting surfaces of composite constructions can be designed to meet strength and stiffness at minimum weight.

The SOP coding of FASTOP will be replaced with the new ASOP-3 code. Appropriate considerations will be given to data management to insure full compatibility with the flutter optimization portion of the program. Logic for rounding results to an integer number of layers and revised output reflecting the addition of composite material will be included. Two composite lifting surfaces will be studied and the results documented.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0022, A CASE STUDY OF THE NEW YORK-ALBANY CORRIDOR - THE COST OF FEASIBLE IMPROVEMENTS AND THEIR EFFECT ON MODAL SPLIT

L.J. PIGNATARO, Polytechnic Inst. of New York, School of Science & Engin., *Brooklyn, New York* 11201 (100421 (HRB NO.))

A study of the relative costs and efficiencies of the various intercity passenger transport modes operating in the New York-Albany corridor is underway. Unit cost models have been prepared for existing modes as part of the first-year effort. Second-year activities include investigations of potential high-speed rail improvements and the feasibility of STOL/VTOL service in the corridor. A corridor model is also being prepared.

SUPPORTED BY Polytechnic Inst. of New York

1.0023, INVESTIGATION TO VALIDATE A METHOD OF NONDESTRUCTIVE EVALUATION OF CIVIL AIRPORT PAVEMENTS

UNKNOWN, Yang Stevens Fabian Engineers, *New York, New York* 10017 (FA77WA-3964; FA160049 (TRAIS NO.))

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0024, DICEF UPGRADE

J.B. MCEVOY, U.S. Air Force, Rome Air Development Ctr., *Rome, New York* 13440 (DF721090)

To upgrade the digital communications experimental facility (DICEF) so that the facility is in a continuing position to provide the maximum benefit to the Air Force digital communications program.

To continually study and plan for upgrading the DICEF so that it is always responsive to AF/DoD needs. Includes purchase of off-the-shelf items, in-house fabrication, software development, and some limited testing. Report DICEF capability so that AF/DoD users are aware of the capability at their disposal.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

1.0025, ADV DIAGNOSTIC ENGINE MONITORING SYSTEM APPLICATION ASSESSMENT (ADEMS II)

W.R. PETERS, General Electric Company, *Cincinnati, Ohio* 45215 (DF455480; F33615-76-C-2025)

The objectives of this program are to design, develop, and evaluate advanced state-of-the-art in-flight computative and

sensing techniques incorporated in an advanced diagnostic engine monitoring system (ADEMSII). This system is specifically designed and developed for installation in selected operational C-5A aircraft for the flight evaluation of capabilities to monitor the condition of one of the TF39-GE-1A engines. This program will provide valuable information on the operational effectiveness of the system incorporated techniques for reducing field maintenance work through correct and timely maintenance actions based upon improved fault isolation and trending capabilities, provide data for effecting cost-saving logistic management improvements, and establish engineering guidelines for diagnostic engine monitoring applications for future military aircraft.

The airborne system shall incorporate on-board fault detection pre-and post-failure event recording, selected airborne limit exceedance displays, self-check capability, and provide data for ground processing to develop and define the methodology for in-depth fault isolation, trending for the prediction of maintenance requirements, and history/statistical data for tracking life-limited parts for logistic management purposes. Limited engine modifications for the installation of IR pyrometer, internal vibration (externally removable), oil system monitoring and other advanced sensors are required. This work is to be accomplished in six phases: design and definition of adems system and hardware, procurement fabrication and assembly, total system and engine assurance testing, installation and flight evaluation, technical reporting, and low cycle fatigue damage analysis.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0026, EXPERIMENTAL FLIGHT TEST EVALUATION OF J79 B/AL BLADES

R.J. STABRYLLA, General Electric Company, *Cincinnati, Ohio* 45215 (DF459270; F33657-76-C-0608)

The objective of this effort is to develop and structurally qualify boron/aluminum J-79 first-stage blades for engine qualification testing and evaluate their durability response during subsequent experimental flight test exposure in an RF4/J79-15 turbine engine.

The approach consists of seven tasks. The first two tasks are to develop B/Al blades having improved bond quality and reproducibility suitable for structural, engine qualification and flight testing. The succeeding three tasks include design analysis and bench and structural FOD tests requisite for proceeding to engine qualification testing. The sixth task consists of the procurement of flight test replacement blades. The seventh task includes component build-up, engine installation, delivery to WPAFB for endurance testing and evaluation of flight test evaluation blades.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0027, SM CO GENERATOR/ENGINE INTEGRATION STUDIES

D.E. UEHLING, General Electric Company, *Cincinnati, Ohio* 45215 (DF460900; F33615-77-C-2018)

To establish and demonstrate the feasibility of integrating a Sm Co starter generator into an aircraft jet engine.

The generator/engine interface will be defined based upon a specific application, the design and performance requirements will be established and a model device fabricated to demonstrate performance.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0028, VISCOUS FLOWS IN HIGH-SPEED FLIGHT

R.T. DAVIS, Univ. of Cincinnati, School of Engineering, *Cincinnati, Ohio* 45221 (DN023017; N00014-76-C-0364)

The development of accurate methods to predict the viscous flow (attached or separated) over broad classes of body shapes is essential for the efficient design of high-speed airplane and missile configurations. This theoretical research will concentrate on the nature of separation and reattachment; the flow about bodies in non-uniform flows; and numerical solutions of the Navier-Stokes equations to assess and to formulate analytical models.

Classically in fluid mechanics the flow about a body is divided into an inviscid external flow covering most of the field and a thin viscous boundary layer. As the Reynolds number decreases and/or the Mach number increases, or if separation plays a significant role, this classical division ceases to be valid; higher order effects become increasingly important. This research will tackle a broad class of such problems with particular emphasis on the separation and reattachment phenomenon.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

1.0029, AIRCRAFT/WEAPON SYSTEM OPTIMIZATION

R.D. DYER, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF140170)

Air-to-ground attack aircraft can experience severe degradation of performance when carrying weapons externally. Internal carriage results in volumetric penalties to the aircraft and presents a difficult design problem for the weapons bay, bay doors and for weapon separation at supersonic speeds. Advanced forms of weapons carriage such as tangent/conformal mount minmize the adverse effects of external carriage and also show promise for providing a better launch environment. The objective of this effort is to develop prediction techniques and design criteria for external and internal carriage of weapons on current and future tactical aircraft to minimize the clean aircraft performance degradation and to reduce operating costs through fuel savings.

Very briefly, the approach to be followed is a combination of experiment, to acquire basic data on aircraft/store compatibility, and theory to interpret these results and develop generalized prediction methods. Specific tasks to be undertaken include development of a computer code of the aircraft/external store interference prediction technique generated under contract F33615-73-C-3018 and updating to maintain its currency, develop weapons bay turbulence reduction devices and validate through wind tunnel and flight test using F-111 aircraft as the test article, develop design criteria for advanced forms of low-drag weapon carriage based on current contracted efforts. Technical problems lie in the complex interference flow conditions involved which force reliance on experimental data as the base for prediction method development. Availability of applicable experimental data will be a pacing factor.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0030, IMPROVED AEROELASTIC TAILORING AND STRUCTURAL OPTIMIZATION

T.J. HERTZ, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF140800)

Through the application of aeroelastic tailoring of advanced composite structures, it has been shown feasible to aeroelastically deform the lifting surfaces of advanced fighter aircraft to provide improved performance of these aircraft. Prevention of flutter in thin wings has been achievable analytically while providing minimum drag and maneuver load relief. With the improvements in the wing aeroelastic synthesis procedure (computer program TSO), such as the addition of flexible control surfaces and improved drag calculations, the possibility of increasing the uses of the computer program (TSO) exist. The objective of this work unit would be to continue work on the computer program (TSO) in order to increase its efficiency, improve its optimization scheme, and increase the potential for use on a wider range of aircraft.

The approach to the program would be divided into two parts running concurrently. The first part would concentrate on improving the efficiency of the computer program (TSO) and improving and/or replacing the optimization scheme and other algorithms in order to apply it to a wider range of problems (i.e. nonplanar wings, wings with stores). The second part, begun shortly after the start of the program, would be devoted to the use of the computer program (TSO) on two aircraft configurations. These aircraft configurations would be selected on the basis of most beneficial application of aeroelastic tailoring.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0031, EXPERIMENTAL RESEARCH OPERATIONS
M.E. HILLSAMER, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF133130)

Experimental test facilities are required for the support of research efforts in fluid mechanics, propulsion and the aerodynamics of military aircraft and missiles. Fundamental concepts relating to weaponry utilize test facility data for validation, and input is required for checks on analytical and computational methods in fluid dynamics. It is the objective of this work unit to provide operational support for the research facilities and develop improved instrumentation and testing techniques.

Conduct experimental aerodynamic and fluid dynamic research studies in support of other in-house work units under projects 2307 and 1366 using facilities that span the range from Mach 3 to 14 with emphasis on tests in the Mach 6 high Reynolds number facility. Support will also be provided to AFAPL efforts in facilities that share equipment and utilities with the AFFDL-owned wind tunnels, such as the combustion test facility and the compressor test facility.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0032, DEVELOPMENT OF NUMERICAL TECHNIQUES FOR PREDICTING AERODYNAMIC HEATING TO FLIGHT VEHICLES
A.B. LEWIS, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF135950)

At speeds above Mach 3.5 aerodynamic heating is a design constraint for both aircraft and missiles. Definition of the heating environment is necessary for the design of thermal protection systems and the vehicle structure. Hence, poor definition of the thermal environment will result in improper selection of material and structure which can increase acquisition cost and degrade vehicle performance. This effort has as its objective the development of an analysis technique to predict the aerodynamic heating to vehicles of arbitrary geometry. This will improve the ability to determine the heating levels and to perform trades which can reduce acquisition cost.

Several programs designed to predict pressure distributions, boundary layer behavior and heat transfer rates are being examined to meet weaknesses found in the Dejarnette and hypersonic arbitrary body codes. Codes which show a capability to improve on current prediction techniques will be modified to do only the type of calculation required and to make the input compatible with existing programs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0033, AIRCRAFT EQUIPMENT VIBRATION TEST CRITERIA
R.W. SEVY, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF136640)

Aircraft equipment vibration test spectra, estimated by contemporary methods, are in many cases overly conservative in amplitude and unrepresentative in spectral form. In addition, aircraft stores criteria do not adequately address effects of mass distribution and rack sensitivity. These deficiencies result in inadequate design, excessive costs and unrealistic laboratory tests. To mitigate these penalties it is necessary in the case of equipment to develop a test criterion that can be tailored to the specific mounting method, the location and to the aircraft class and operational category, and in the case of stores to develop criteria which will satisfy mass distribution and rack requirements.

Develop and apply transfer functions that relate the source of vibratory energy to the interface and which take into account equipment and store mounting methods. Develop vibration test spectra whose programmed, sequential application to the equipment represents the significant vibration sources during each major flight condition, such as takeoff, climb, low-level dash, cruise, combat turns, etc. Results shall be used in formulation of revised test criteria for method 514, MIL-STD-810C.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0034, AN EXPERIMENTAL STUDY OF THE NOISE-GENERATING MECHANISMS IN SUPERSONIC JETS
D.K. MCLAUGHLIN, Okla. St. Univ., School of Engineering, *Stillwater, Oklahoma* 74074 (NSG 1467)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0035, AIRCRAFT-STORES HEATING
D. MATTHEWS, Arnold Research Org. Inc., *Tullahoma, Tennessee* 37389 (DF420868; F40600-75-C-0001)

To 1) correlate wind tunnel and flight test heating data on an external store, 2) obtain a computer solution to provide store temperature distribution for flight conditions, 3) conduct analysis.

1) Conduct experimental flight test at Edwards AFB using an F111, 2) conduct wind tunnel measurements using thermographic phosphorus technique, 3) develop a correlation between flight test and wind tunnel results.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Arnold Engineering Development Center

1.0036, FLEXLODS UPDATE - GUST LOADS COMPUTATION
J.J. HOSEK, General Dynamics Corporation, *Fort Worth, Texas* 76101 (DF135540; F33615-75-C-3131)

Current military specifications on airplane strength and rigidity (MIL A-8860 series) do not delineate requirements for flexible airframe structural design on aircraft which employ direct lift devices and the AFSC design handbooks do not outline procedures to structurally account for direct lift airframe loads in design. The purpose of this effort is to extend the capability of the computer program developed under contract F33615-74-C-3010 project number 1367 'development of airframe structural design load prediction techniques for military aircraft' to include the capability for computing gust response loads. The extended program shall have the capability to compute the response of the aircraft to flight through random turbulence by power spectral density techniques and also the capability of computing the response to discrete gust profiles.

Structural design load prediction techniques shall be established for important airframe gust design conditions which employ direct lift and side force devices. The program shall also establish a design base for the development of aerodynamic and structural loads prediction techniques for flexible military aircraft by utilizing the sizable quantities of wind tunnel and flight test data available from current weapon systems. The requirements of MIL-A-008860 (USAF) series, airplane strength and rigidity, 31 Mar 71, shall form the baseline against which the theoretical prediction techniques will be developed. The established base will serve as a means for incorporating existing and future systems data into basic techniques to further improve the accuracy of predicting aerodynamic and gust loads. Assimilation of such data will improve prediction techniques and design accuracy.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0037, THE LARGE-SCALE COHERENT STRUCTURE IN THE CIRCULAR JET
A.K. HUSSAIN, Univ. of Houston, School of Engineering, *Houston, Texas* 77004 (NSG 1475)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0038, FLIGHT OPERATIONAL FIBER OPTIC DATA LINKS
L. STEWART, Spectronics Incorporated, *Richardson, Texas* 75080 (DF110470; F33615-77-C-1226)

The objective of this effort is to demonstrate flightworthy and operational system compatibility aspects of wideband fiber optic point-to-point links. Recent experiments have shown that

available fiber optic technology can be used to satisfy low data rate requirements within modern aircraft.

Two wideband fiber optic data links will be designed and installed on an RC135 A/C for performance evaluation during operational flight tests. The links will be designed to interconnect (1) the ARC-259-41A, IF processor and the QRC-259-51, pan display (160 mHz bandwidth) and (2) two QRC245A(t)-1A-1 VIDIS video distribution units (20 mHz bandwidth). A final report will be prepared after flight tests are completed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

1.0039, INVESTIGATION OF THREE-DIMENSIONAL SHOCK WAVE BOUNDARY LAYER INTERACTIONS

J. STOLLERY, Cranfield Inst. of Technology, *Cranfield, England, United Kingdom* (DF138630; AF-AFOSR-3006-76)

Aerodynamic heating to aircraft and missiles is a design constraint at high supersonic Mach numbers. Our knowledge of fundamental flow phenomena can lessen the impact of this design constraint and expand the operating corridor of the system. First effects of heating are felt in regions of complex flow interaction which are severely complicated by the existence of streamwise vorticity. It is the objective of this effort to investigate the significance of streamwise vorticity in the development of three-dimensional interaction phenomena.

Experimental observations will be made to supplement and focus the existing body of experimental data toward the understanding of vortical influence in such interactions. Concurrent experiments in the U.S. (AFFDL) and England (Cranfield) are planned.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0040, PARAMETER IDENTIFICATION OF HEREDITARY SYSTEMS

E.M. CLIFF, Virginia Poly. Inst. & St. U., School of Engineering, *Blacksburg, Virginia* 24061 (DF139650; AF-AFOSR-3221-77)

This work unit supports in part the AFFDL/FGC basic research plan that is intended to provide experimental methods to validate theoretical unsteady aerodynamics. The identification of these experimental aerodynamics will provide for safer control of aircraft flight. The specific objective of this work unit is to develop a parameter estimation method for a flexible aircraft described by state equations containing a convolution of the approximate Kussner/Wagner functions with the lifting-surface steady aerodynamic methods. When these experimental data are better estimated and incorporated into design, the response of aircraft conventional and advanced control systems will be more rapid.

The hereditary models for a system with memory shall be generalized to include time delays on each state. The estimation procedure to identify the aerodynamic parameters of a and b, in the state, e.g., dx/dt equals ax(t minus c)plus bu, will then be developed for c constant, c dependent upon state.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0041, NAVY VEHICLE DESIGN AND CONSTRUCTION - LINE VORTEX GENERATORS

R.P. WHITE, Systems Research Labs. Inc., *Newport News, Virginia* 23602 (DN475168; N00014-74-C-0091)

To develop predictive capabilities for the application of existing and new vortex control concepts to tactical aircraft wing design, and to investigate the static stability characteristics of aircraft that produce large increments of vortex-induced lift. Through control of the wing/vortex interaction, large values of incremental lift can be generated. This induced lift capability has the potential for large improvements in combat maneuverability through increased maneuver load factors and operation at angles-of-attack beyond the stall range of conventional wings.

The approach to developing the predictive capability for implementation of vortex control high-lift devices is through a systematic theoretical analysis and experimental investigation of the wing-vortex interaction. A potential flow theoretical model is being used to identify key parameters, analyze multiple wing-vortex interactions and develop design criteria for improved vortex control devices. Wind tunnel tests are being conducted to provide performance characteristics and flow field information to demonstrate improved vortex suction lift capability and to provide a data base for comparison with theory.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

1.0042, COMPARATIVE STUDY OF FLARE CONTROL LAWS

W.J. BREEDLOVE, Old Dominion University, School of Engineering, *Norfolk, Virginia* 23508 (NSG 1480)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0043, BOUNDARY LAYER CONTROL

J. VACHAL, Boeing Company, *Seattle, Washington* 98108 (DF136030; F33615-76-C-3035)

The requirement for lonng-ange, efficient military transport aircraft has been intensified by the current fuel shortages and the lengthening of resupply missions due to unavailable refueling bases. An assessment of the myriad of aerodynamic methods for reducing the fuel consumption of transport aircraft has shown that laminar flow control by suction offers the greatest potential for achieving long-range or high-endurance aircraft designs with significantly reduced fuel usage. Laminar flow control has not been applied to transport aircraft because the technology for economic application was deficient at the time of the X-21 flight demonstrations. The detail design study of a large, long-range military transport will determine if current technology is completely adequate to build an efficient laminar flow control military transport with significant fuel and direct operating cost savings.

A military transport design study will be performed to assess the merit of advances in technology in relation to producing a reliable laminar flow control aircraft. The design study will also delineate the requirements that must be accomplished by a technology demonstration aircraft to provide definitive design data. Additionally, the results of a previous survey will be updated as data from currently in-progress wind tunnel and flight tests become available.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, HOMOGENEOUS AND HETEROGENEOUS HYDRAZINE DECOMPOSITION FOR MONOPROPELLANT PROPULSION SYSTEMS

D.M. GOLDEN, S R I International, *Menlo Park, California* 94025 (DF036960; F44620-73-C-0069)

AF function - many advanced spacecraft utilize hydrazine monopropellant thrusters for accurate pointing, positioning, and station-keeping in orbit. Deficiency - the lifetime of these spacecraft is limited by the monopropellant system because of reduced effectiveness -poisoning - of the monopropellant catalyst. Objective - detailed investigation of the causes of catalyst activity decay exhibited by hydrazine fuel thrusters employing a packed bed of granular alumina -supported iridium catalyst and operating in a pulse mode under limit cycle conditions. How work contributes - this work will lead to extended spacecraft lifetimes and a corresponding reduction in life-cycle costs for the military space program.

This effort consists of two concurrent experimental efforts. The first consists of surface related studies of iridium catalysts and examines the modification of catalyst surface properties by metal additives, the effects of pore diffusion on catalytic activity

and the effects of crystal orientation and surface defects on catalytic activity. The second effort deals with kinetic studies of the catalysts and develops the time- and exponent-dependent kinetics as well as determining the steady-state flow activity.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0002, PVF2 TRANSDUCERS FOR NONDESTRUCTIVE EVALUATION OF CERAMICS AND BRITTLE MATERIALS
H.J. SHAW, Stanford University, W.W. Hansen Lab. for Physics, *Palo Alto, California* 94305 (DF049450; AF-AFOSR-3386-77)

AF function - ceramic materials are being developed for a variety of components (e.g., blades, vanes, combustors, bearings and seals) in future gas turbine engines and for a variety of electronic and optical components in aircraft. Because ceramics and new brittle metal alloys fail catastrophically from pre-existing flaws or cracks, new nondestructive evaluation, NDE, techniques are required to locate and reject these defects. Opportunity - an important new material, polyvilidene fluoride (PVF2), has been found to have properties particularly suitable for operation as a high-frequency ultrasonic transducer. Objective - this research seeks to understand and develop the utilization of PVF2 for application to NDE of ceramics and brittle metals. How work contributes - high-frequency, and flexible geometry will allow flaw detection on complex geometries such as turbine blades.

This research will develop the theory, the optimum geometrical configuration and the design curves for PVF2, multilayer transducers. The desired insertion loss, bandwidth and acoustic beam shape will be optimized for the excitation of bulk and surface waves.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0003, THERMODYNAMICS, METALLURGY AND PHASE STABILITY OF HIGH-TEMPERATURE SUPERCONDUCTORS
G.W. WEBB, Univ. of California, Graduate School, *San Diego, California* 92037 (DMR77-23774)

An investigation will be made of the properties of high transition temperature superconductors. The study will focus on thermodynamic stability and normal state electrical resistivity. The microscopic factors leading the very high values of room temperature resistivity in certain high transition temperature compounds will be investigated. Heat capacity measurements will be used as a probe of the thermodynamic stability. The connection between unusual features of the resistivity and heat capacity will be experimentally explored in a number of superconducting compounds.

Research previously supported under DMR75-04019. This is the first year of a 3-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

3.0004, HIGH-TEMPERATURE MECHANICAL PROPERTIES OF POLYPHASE CERAMICS BASED ON SILICON NITRIDE
F.F. LANGE, Rockwell International Corp., *Thousand Oaks, California* 91320 (DF048040; F49620-77-C-0072)

AF function - Air Force propulsion systems and missile nosecones require high-temperature structural members such as can be provided by the unique properties of ceramics materials. Opportunity - an understanding of high-temperature creep and slow crack growth in ceramics will lead to an increase in the safe operational lifetime of this material. Objective - this research will define the interaction of composition and microstructure with creep, slow crack growth and creep rupture so as to control these critical properties. How work contributes - this work will lead to an extended lifetime of high-temperature ceramic engines.

High-purity silicon nitride will be hot pressed with additives to near theoretical density. The composition and microstructure of the grain boundary phase will be critically examined over a range of heat and stress treatments. Four-point flexural strength, compressional and tensile creep and double-torsional crack-opening-displacements will be performed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0005, NEW CHEMICAL ANALYSIS TECHNIQUES
R.E. SIEVERS, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (DF042170; F44620-76-C-0031)

AF function - advanced analytical and experimental techniques are needed to support the Air Force mission in the sensing and detection areas. Deficiency - this area of research has need of measurement techniques that are highly sensitive and selective. Objective - the program deals with several distinct and interrelated measurement techniques which includes chromatographic separation and mass spectrometric analysis of isotopes, metal complexes that are highly soluble in organic solvents, nuclear magnetic resonance of metal chelates, thermal gravimetric analysis, environmental analytical chemistry, and trace analysis. How work contributes - volatile metal chelates will be exploited to develop more rapid separation and accurate analytical methods in order to determine very low but significant concentrations of metals and their compounds, that play a part in engine wear and pollution problems.

In materials technology there is a continuing need for fluids that will withstand high temperatures without thermal, hydrolytic or oxidative breakdown. A synthesis and materials characterization study will be carried out on new metal chelates that are potential candidates as high-temperature fluids. A system is being developed, capable of analyzing small concentrations of nitrogen oxides, hydrocarbons, and various trace metals, using gas chromatography coupled with a microwave excited emission detector. This method of detection is inherently selective in its mode of action, highly sensitive, and applicable to quantitative and qualitative analysis.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0006, EXPERIMENTATION STUDIES OF THE FORMATION/DEPOSITION OF SODIUM SULFATE IN/FROM COMBUSTION GASES
D.E. ROSNER, Yale University, School of Engineering, *New Haven, Connecticut* 06520 (NSG 3169)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0007, WEAPONRY - RESEARCH SUPPORTING JET PROPULSION TECHNOLOGY (PROJECT SQUID)
S.N. MURTHY, Purdue University, Purdue Research Foundation, *Lafayette, Indiana* 47907 (DN524574; N00014-75-C-1143)

In the project 'principles of chemical propulsion and armaments,' this task is a major effort in support of jet propulsion technology, generating understanding and expansion of knowledge required for the development of jet devices used in naval aircraft missiles and space vehicles. The objectives of SQUID are: (1) stimulate interests of scientists and engineers in solving Navy-related problems, (2) plan and support basic and applied research relating to jet propulsion, and (3) provide capability for conducting special studies, consulting, and probing new avenues of relevant research.

Project SQUID headquarters office, upon approval of the power program, conducts a subcontracting program on physical and chemical processes of energy transformation in relevant scientific areas pertinent to jet propulsion.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0008, ENVIRONMENT - FATIGUE INTERACTIONS IN FIBER REINFORCED COMPOSITES
M.E. ROYLANCE, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0F4742)

To assess the influence of an accelerated environment (high-temperature, humidity, and ultraviolet radiation components) on the fatigue lifetime of fiber-reinforced polymer composites, to identify material degradation mechanisms, and to optimize the

environmental fatigue resistance of these composites for use in dynamic structural elements in Army ground vehicles and aircraft. Special efforts will be directed toward study of effects of moisture on mechanical and dynamic mechanical properties.

Various thermosetting and thermoplastic matrices, reinforced with glass, graphite, and kevlar fibers, will be fabricated by means of a wide variety of processing methods and subjected to cyclic tension -tension fatigue loads while exposed to an accelerated deteriorative environment. Statistical lifetime distributions will be obtained as a function of mean load, and the data correlated with current theories of cumulative damage and crack growth in composites. Materials deterioration mechanisms will be identified by analytical chemical and microscopy techniques, and processing methods will be developed to eliminate or minimize these mechanisms. Mechanical loss and stiffness, and specimen temperature, will be monitored to develop measures of fatigue damage.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Materials & Mechanics Research Center

3.0009, HIGH TEMPERATURE RESISTANT POLYMERS FOR LASER HARDENING APPLICATIONS

S.E. WENTWORTH, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0F4696)

To develop high temperature resistant polymers possessing thermal and thermomechanical stability to 400 degrees C while maintaining ease of processability. Based on the observation that a principal effect of high-energy laser radiation on organic materials is thermal degradation, the above polymers would be useful for the production of laser hardened structural elements, especially for Army aircraft. Although complete protection could not be provided by the use of these materials, a higher level of survivability would certainly be imparted. Major thrust-survivability.

Polyphenylquinoxalines (PPQ's) are superior materials in terms of their ease of processing, thermal stability and high char yields, all of which make them prime candidates for laser hardening applications. PPQ's have one serious deficiency, however, which must be eliminated before they can be effectively utilized. This is thermoplasticity above about 350 degrees C which results in loss of mechanical properties above this temperature. Several attempts to solve this problem by means of crosslinking have been developed and tested on a laboratory scale. An objective of this program is to validate these results for structural elements, especially under laser radiation. In addition, exploratory synthesis of new crosslinkable PPQ's will be pursued to further improve the thermooxidative stability of such resins. Finally, exploratory synthesis of entirely new resins systems will be undertaken. (It is noted that the previously identified problem of high cost for PPQ's has been substantially reduced as a result of the efforts of a Navy contractor, thereby making PPQ that much more attractive.)

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Materials & Mechanics Research Center

3.0010, MARTIAN CHEMISTRY RELEVANT TO BIOLOGICAL ACTIVITY AND THE VIKING LABELED RELEASE EXPERIMENTS

R.C. PLUMB, Worcester Polytechnic Inst., Graduate School, *Worcester, Massachusetts* 01609 (NSG 7392)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0011, HARP DATA REDUCTION

W. SHARP, Univ. of Michigan, School of Lit. Sci. & The Arts, *Ann Arbor, Michigan* 48104 (DF048410; AF-AFOSR-3320-77)

AF function - aurora emissions caused by high-energy particles deposited in the ionosphere, provide a noisy IR background for satellite surveillance and detection systems. Deficiency - the characterization of the high-energy particles fluxes is insufficient to determine and predict the IR background sufficiently. These noise filters cannot be finely tuned nor auroral events distinguished from targets. Objective -this grant will allow analysis of data collected by a Univ. of Michigan instrument aboard an AF satellite. This data should better specify the energetic electron spatial distribution, the energy distribution among the electron, and the correlation with the resultant aurora. How work contributes - add to our knowledge of electron flow and energy deposition and resultant aurora.

Data collection, partially funded by NASA, is complete. Grant would be for reduction and analysis.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0012, EXPERIMENTAL STRESS ANALYSIS OF COLD-WORKED FASTENER HOLES

W.N. SHARPE, Michigan State University, School of Engineering, *East Lansing, Michigan* 48824 (DF040870; AF-AFOSR-2817-75)

AF function - increases in reliability, durability and damage tolerance for advanced aerospace vehicles is required to reduce Air Force cost of ownership and increase flight safety. Deficiency - fatigue damage of mechanically fastened structures is resulting in excessive maintenance costs and flight failures of aircraft. Objective - the objective of this research is to understand the development and behavior of residual strain fields surrounding cold-worked fastener holes under fatigue loading. How work contributes - fundamental understanding of these residual strains can significantly reduce empirical testing and increase airframe design confidence levels.

This research will experimentally study the fatigue behavior of cold-worked fastener holes. The program is divided into three phases. Phase I - measurement of the radius of the elastic-plastic interface around the hole. Phase II - study of the strain field changes associated with crack initiation, crack growth, and measurement of stress intensity factors. Phase III - measurement of residual strains around holes that are cold-worked after a crack has already initiated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0013, EVALUATION OF METHODS TO PRODUCE AVIATION TURBINE FUELS FROM SYNTHETIC CRUDE OILS

H. SHAW, Exxon Res. & Engineering Co., *Linden, New Jersey* 07036 (DF456950; F33615-74-C-2036)

This program will be conducted in three phases. The objective of Phase I is to determine which raw materials and processes will provide refinery feedstocks most amenable to production of finished aviation turbine fuel. Raw materials will include coal and oil shale and their individual sources. The objective of Phase II is to provide an experimental base in support of production of aviation turbine fuel from synthetic crude oil. Phase III will provide an overall assessment of material, equipment and processing requirements for producing the high yields of aviation turbine fuels from coal and oil shale.

Phase I will consist of an engineering analysis and include a literature survey. Raw materials, processes, synthetic crude oils and refinery feedstocks will be selected for further study in the later phases. Phase II will be limited to laboratory bench-scale experimentation as pilot plant work is not within the scope of this program. Under Phase III requirements unique to production of aviation turbine fuels and to production of other liquid products (gasoline, heating fuels, etc.) will be identified.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

3.0014, CONTROLLED GRAIN BOUNDARY STRUCTURES IN THIN FILM SUPERCONDUCTORS

E.J. KRAMER, Cornell University, School of Engineering, *Ithaca, New York* 14850 (DF037890; AF-AFOSR-3107-77)

AF function - superconducting materials are needed for application in airborne multimegawatt power generation and power conditioning systems. Opportunity - research specifically directed

towards synthesis, preparation and characterization of high transition temperature metallic compounds can provide a greater margin of design efficiency and operational reliability. Objective - this research is concerned with the preparation of superconducting films with controlled grain boundary microstructures and with the mechanisms of flux pinning due to such controlled microstructures in metals. How work contributes -the performance of high field magnets and solenoids, electric motor windings, superconducting rotors in power generators and inductive energy storage systems could be significantly improved in AC power distribution losses, current transients and mechanical breakdown of the superconductor were reduced.

To prepare controlled grain boundary structure films original techniques are being utilized. Two epitaxial thin films of superconductors are deposited on single-crystal substrates of gold or silver in an ultra-high vacuum chamber and subsequently welded together by hot pressing them into contact to produce a bicrystal film with a grain boundary of controlled misoriented structure in the plane of the films. Annealing at elevated temperatures permits grain boundary migration to either surface of the film producing a grain boundary structure normal to the plane of the film and of a predictable grain size. The flux pinning process is then related to current-voltage characteristics, metallurgical microstructure and crystallographic texture of A-15 compounds.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0015, FUNDAMENTAL STUDIES IN FT MATERIALS

A.F. ARMINGTON, U.S. Air Force, Rome Air Development Ctr., *Rome, New York* 13440 (DF902910)

AF function - navigation, surveillance, communication. Deficiency - presently used quartz resonators lack radiation hardening and long-term stability. Objective - to improve quality of resonator materials. How research contributes - fabrication of resonators from this material should result in improved radiation hardening and frequency stability for use in satellites and other Air Force systems.

New solvents will be used in hydrothermal studies to seek improved materials. Addition of specific impurities into quartz by solid-state electrolysis will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

3.0016, FLUX PINNING AND CRITICAL CURRENTS IN A-15 SUPERCONDUCTORS

J.D. LIVINGSTON, General Electric Company, *Schenectady, New York* 12305 (DF040580; F44620-75-C-0044)

AF function - high-temperature superconducting materials are needed for application in airborne multimegawatt power generation and power conditioning systems. Opportunity - research specifically directed toward the synthesis and characterization of high transition temperature metallic compounds can provide a greater margin of design efficiency and operational reliability than presently available superconductors. Objective - this research involves the synthesis and preparation of binary and ternary A-15 metallic compounds for the purpose of studying flux-pinning mechanisms in superconductors. The objective is to further the understanding of the relationships between processing variables, stabilization mechanisms, metallurgical microstructure, and the superconducting properties of A-15 compounds such as Nb3Sn, V3Ga, V3Si, Nb3Si and Nb3Ge. How work contributes - the performance of high field magnets and solenoids, electric motor windings, superconducting rotors in power generators, transformers and induction energy storage systems could be significantly improved if the upper critical field, the current-carrying capacity and the critical transition temperature of the superconducting material could be enhanced. In addition, AC power distribution losses, transients and mechanical breakdown of the superconductor need to be reduced.

For multifilamentary copper-matrix composites, the major processing variables are reaction temperature, time and chemical composition. Grain size is believed to be the major metallurgical variable determining critical currents. Effects of composition on A-15 compound formation and properties, and possible introduction of precipitation by heat-treatment, is being studied by applying external coatings of various alloying elements to multifilamentary composites, and by preparing and heat-treating arc-castings of ternary compounds of general composition A3(B,B'). The role of oxygen, silicon and magnesium is being investigated for achieving high critical temperatures in thin films of Nb3Ge and Nb3Si grown by physical vapor deposition.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0017, TURBINE ENGINE LUBRICANT DEVELOPMENT

G.A. BEANE, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF451060)

Develop new lubricants and define requirements for current and proposed turbine engine and power generation systems.

Provide engine lubricant requirements to industry in terms of physical properties and performance criteria. Conduct laboratory and full-scale engine tests to ensure oils meet these requirements, and study advanced lubricant capabilities. Evaluate the toxicological characteristics of lubricant formulations and additives considered suspect.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

3.0018, PARAMETERS AFFECTING THE THERMAL STABILITY AND HEAT SINK OF HYDROCARBON AIRCRAFT FUELS

R.P. BRADLEY, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF453720)

The objective of this study is to provide the information necessary for specifying fuels which will be capable of providing cooling and propulsion for engines powering aircraft in the speed range from subsonic to above Mach 3. Both conventional and new thermal stability devices will be evaluated with regard to the effect of the following variables on test precision and the significance of results: 1. Pretest filtration - necessity and amount, 2. Dissolved oxygen - level and control, 3. Test pump contributions, 4. Procedural techniques -controlling certain areas, 5. Test preparation and procedure.

The ASTM fuel coker, the jet fuel thermal oxidation tester, and the MINEX III will be evaluated with regard to the effect of the following variables on test precision and significance: (1) flow rate variation, (2) test time, (3) dissolved oxygen content, (4) test section metallurgy, and (5) procedural effects. New techniques for interpreting degree of deposition will be investigated including light reflectance, beta-ray backscatter, heat transfer degradation, and gravimetric techniques. A thermal stability survey of JP-4 using both the ASTM fuel coker and the jet fuel thermal oxidation tester will establish the basis for incorporating the jet fuel thermal oxidation tester into MIL-T-5624. The small-scale studies will be closely coordinated with the advanced aircraft fuel simulator program to establish the significance of the small-scale results to engine performance. Standardized fuels of known properties will be preserved in cold storage at 30 & 10 degrees F.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

3.0019, EVALUATION OF SPECIAL AVIATION TURBINE FUELS PRODUCED FROM PETROLEUM, COAL AND OIL SHALE

C.L. DELANEY, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF457580)

Establish an engineering data base that can be used to support decisions made to increase aviation turbine fuel availability. Near-term decision will have to be made relative to changing property requirements of military fuel specifications as a means of increasing aviation turbine fuel yield from petroleum resources. Mid- and far-term decisions will have to be made relative to developments and use of aviation turbine fuels from coal and oil shale resources. Use of aviation turbine fuel derived from coal and oil shale will involve further decisions relative to changing specification requirements to accommodate the different chemistry and economics associated with development of these resources.

(1) Petroleum-derived fuel - quantitatively determine both the individual and collective impact of specification properties on grade JP-4 yield. Evaluate the effect of extending the range of availability-related properties on aircraft performance and materials. (2) Coal- and oil shale-derived fuel - evaluate fuel produced from coal and oil shale crude oils as these crude oils become available from commercial sources. All aspects related to storage and usage of these fuels will be examined including blending with petroleum-derived fuels. Exhaustive laboratory and full-scale tests will be performed to determine if these fuels can be used interchangeably with petroleum fuels.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

3.0020, APPLIED NONLINEAR INTERACTIONS IN GASES AND PLASMAS

P.W. SCHREIBER, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF458810)

AF function - laser development, combustion studies, compressor studies, chemical emissions, aerodynam-c testing. Deficiency - on-site methods are needed to determine temporarily and spatially resolved species concentrations in reacting and non-reacting flows. Research -development of an experimental and theoretical base for the applications of nonlinear and linear spectroscopy to the measurement of species concentrations, temperature and velocity in plasma and gases. How research contributes - recent experimental and theoretical studies in nonlinear optics indicate that these effects may provide powerful new methods to measure spatially and temporally resolved temperature, species concentrations, and velocity in laser and combustion media. These effects will be explored analytically and experimentally for potential applications to current Air Force problems. Where applicable, programs will be initiated to develop the required optical systems for the evaluation of the new techniques.

Nonlinear effects such as stimulated Raman scattering (SRS), stimulated Brillouin scattering (SBS), and coherent anti-Stokes Raman scattering (CARS) have been generated in the laboratory in gases. In particular, CARS has been observed at low pressures for a large number of molecules. These effects will be evaluated analytically and experimentally as potential methods to measure temporally and spatially resolved temperature, velocity and number density distributions in combustion laser, and gas dynamic systems of interest to the Air Force. Special emphasis will be placed on the evaluation and interpretation of experimental data realistic environments.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

3.0021, OXIDES TES FEASIBILITY INVESTIGATION

J. DAVISON, Univ. of Dayton, Res. Inst., *Dayton, Ohio* 45409 (DF459920; F33615-76-C-2096)

To experimentally demonstrate the feasibility of alloying and employing mixed metallic oxides at eutectic compositions as thermal energy storage materials in the 1000-1800 degrees F temperature range. The candidate materials should provide heats of transformation greater than 100 W-hr/lb.

Review published phase diagram literature on mixed oxides and recriprocal eutetics, fabricate encapsulated TeS materials and test at or above eutectic temperature for 2000 hrs, measure volumetric change of transformation, thermal conductivity and specific heat of candidate TeS material, evaluate clad-TeS corrosion at conclusion of 2000 hr test, and prepare the final report.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

3.0022, THE INFRARED SPECTRUM OF GASEOUS N2O5

R.W. LOVEJOY, Lehigh University, Graduate School, *Bethlehem, Pennsylvania* 18015 (NCA 2-380801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0023, MECHANISM OF PYROELECTRICITY IN POLYVINYLIDENE FLUORIDE FILMS 13268-C

M.M. LABES, Temple University, School of Liberal Arts, *Philadelphia, Pennsylvania* 19122 (DA0R5577; DAAG29 76 G0040)

To identify the limits achievable in the pyroelectric coefficients of polar polymers, to determine if PVF sub 2 is an optimum material, to attempt to improve the performance of polymeric pyroelectrics, and to develop a theory for pyroelectricity in polymeric materials. This work will be directly responsive to (1) the NVL pyroelectric vidicon infrared imager in connection with base installation security systems, (2) the AMMRC mission dealing with the monitoring of vibration and temperature in helicopter power trains through the use of these polymers, and (3) the ECOM for the development of systems which in many cases incorporate sensor sub-systems which operate in the infrared.

Predictions for several mechanisms for the poling process and for the temperature dependence of the polarization will be compared with experimental results. Theoretical analysis will be used to design experiments which will aid in the development of a theory for the nature of pyroelectricity in polymers. Various experiments will be conducted including the poling of multilayer samples and stretching and poling simultaneously. Structure and property experiments will also be conducted.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

3.0024, COMPOSITE SUPERCONDUCTORS

J.R. GAVALER, Westinghouse Electric Corp., *Pittsburgh, Pennsylvania* 15235 (DF038430; F44620-74-C-0042)

AF function - high-temperature superconducting materials are needed for application in airborne multimegawatt power generation and power conditioning systems. Opportunity - research specifically directed toward the synthesis and characterization of high transition temperature metallic compounds can provide a greater margin of design efficiency and operational reliability than presently available superconductors. Objective - this research involves the preparation of high transition temperature (above 20 degrees K) metastable metallic alloys and compounds using the low-energy sputtering technique, (CVD) chemical vapor deposition or other novel methods. How work contributes - the performance of high field magnets and solenoids, electric motor windings, superconducting rotors in power generators, transformers and induction energy storage systems could be significantly improved if the upper critical field, the current-carrying capacity and the critical transition temperature of the superconducting material could be enhanced. In addition, AC power distribution losses, transients and mechanical breakdown of the superconductor need to be reduced.

The physical, chemical, metallurgical and structural properties of these materials are being measured and correlated. Optimal characterictics and special properties of these A15 metal compounds are being considered for large-scale aerospace applications and device concepts.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0025, A STUDY OF LOCALIZED PLASTIC DEFORMATION AS RELATED TO FATIGUE MECHANISMS

R.J. ASARO, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DF047680; AF-AFOSR-3246-77)

AF function - certain high-strength structural materials used in aerospace systems (including some aluminum and titanium alloys) are susceptible to the occurrence of strain localization. Opportunity - this phenomenon is due to the development of localized regions which are plastically unstable, and results in severe reductions in fatigue life and ductility. The process is particularly insidious since critical strain for fracture can be locally surpassed at very low average macroscopic strain, thus leading to unexpected premature failure. Objective - this research will: (1) identify the experimental conditions which cause plastic deformation of homogeneous bodies to become localized into intense shear bands, (2) ascertain to what extent these bands cause

material damage, crack initiation or contribute to crack growth, and (3) analyze the initiation of plastic localization both as an abrupt degradation or weakening of the material and also as an instability in the constitutive description of plastic flow. How work contributes - this fundamental study will investigate localized plastic deformation, and the role it plays in fatigue mechanisms, metal ductility, and fracture processes.

Experiments will be performed on single crystals and axisymmetric polycrystalline specimens of aluminum-copper alloys in order to precisely document the conditions of stress state, strain rate, work hardening rate, temperature and metallurgical structure which allow localization of plastic flow to occur. Subsequent studies will include 2000 and 7000 - series commercial aluminum alloys.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0026, RADOME RAIN EROSION EFFECTS
R. KINSLOW, State University & Comm. Coll., School of Engineering, *Cookeville, Tennessee* 38501 (DA0F1358; DAAK40 77 C 0014)

The objective of this research is to develop new improved materials and coatings for missile radomes which are easier to fabricate in production and less vulnerable to field handling than the presently used slip-cast fused silica.

The approach shall be to perform the following tasks: a. Analyze parametrically material erosion properties. B. Determine erosion constants of materials experimentally. C. Make microscopic analysis to determine the relative fracture resistance and crystalline structure. D. Conduct tests to determine the effects of aerodynamic heating and impact angle in terms of material properties. E. Evaluate new radome materials including laminates, composites, and coatings. F. Analyze approximately 25 conical samples eroded in sled tests. G. Compute and measure erosion rates.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Ground Equipment & Missile Structures Directorate

3.0027, NAVY VEHICLE DESIGN AND CONSTRUCTION - FATIGUE OF METAL MATRIX COMPOSITE MATERIALS
M.A. WRIGHT, Univ. of Tennessee, Space Institute, *Tullahoma, Tennessee* 37388 (DN223717; N00014-75-C-0352)

Fatigue is an important factor to consider in many potential Navy composite material applications, such as in components for jet engines and high-speed aircraft skins. Thermal fatigue is a result of imposed, varying strains due to the differential thermal expansions of the composite binder and reinforcement as temperature fluctuations occur. Mechanical fatigue occurs due to varying applied loads. In this research both fatigue modes will be investigated in candidate metal matrix composite materials.

Thermal cycling experiments will be carried out on alumina/aluminum metal matrix composites. Variables to be imposed include cyclic temperature range, imposed external load, stress risers, and environments containing water vapor. Effects of thermal cycling on structure, strength, and failure stress will be determined. Mechanical fatigue testing will show effects of broken fibers, notches, and cross-plying on fatigue strength of alumina-aluminum composites. Transverse fatigue properties will also be measured.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0028, ANALYSIS OF SHRINKAGE IN REUSABLE SURFACE INSULATION
J.I. MUELLER, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (NCA 2-850801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, DELAYED FIN OPENING DESIGN
L.W. LEE, U.S. Army, Missile Res. Dev. & Eng. Lab., *Huntsville, Alabama* 35809 (DA0F1277)

To establish feasibility of delayed fin opening as a method to reduce wind sensitivity of free rockets.

Computer simulations will be conducted to establish the correct design approach. The fins will be designed, fabricated and tested in sled and flight tests.

SUPPORTED BY U.S. Dept. of Defense, Missile Command, Aeroballistics Directorate

4.0002, FLIGHT CONTROL COMPUTER
W.F. OTTO, U.S. Army, Radar Technology Laboratory, *Huntsville, Alabama* 35809 (DA0F1006)

Demonstrate the feasibility of a laser-guided rocket with minimal on-board control devices. Purchase and/or develop computer hardware and software to control the flight of the test vehicle. Develop algorithms for smoothing laser tracker data to determine percent position and velocity and roll of the missile and computation of required trajectory corrections.

Missile control algorithms will be developed and closed-loop performance simulated. Computer-mount and computer-radar interfaces will be tested.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Technology Lab.

4.0003, RESEARCH IN THE OPTICAL SCIENCES
P.A. FRANKEN, Univ. of Arizona, Graduate School, *Tucson, Arizona* 85721 (DF046800; F49620-77-C-0021)

AF function - the Air Force functions of surveillance, reconnaissance, communication, command and control, weaponry, navigation and guidance require coherent light generation, modulation, transmission and detection, and optics associated with these applications. This research will address aspects of stabilized sources, theory of integrated optics and advanced optical design. Opportunity - the proposed work consists of three tasks which impact Air Force interests. These tasks are a follow-on to earlier efforts at the University of Arizona so that the Air Force has an opportunity to obtain important results without the necessity of starting brand new efforts. Objective -this work will undertake an experiment to greatly reduce the uncertainty of a Michelson-Morley type experiment. It will provide an extension of the theory of waveguides as used in integrated optics. Finally, an advanced approach to optical design will be studied. Contributions -this effort will provide important results to the Air Force on the design of optical elements for all types of applications. It will further the theory, and associated experiments, of optical waveguides for integrated optics applications. Finally, the work will provide techniques for ultra-stable lasers as well as reducing global positioning uncertainty.

The proposed work consists of three specific tasks, all of which impact Air Force interests. The first is a 'one-way' experiment which can be considered as the evolution of a Michelson-Morley experiment. The experiment depends on super-stable lasers so it will advance that technology. In principle, the apparatus will be more sensitive than the Michelson interferometer by four orders of magnitude and will therefore greatly reduce global positioning uncertainty. Finally, the experiment is a physically distinct test of special relativity. The second task is an extension of the theory of waveguides as used in integrated optics. This will include theoretical work on the vectorial ray theory of circular fiber waveguides and experimental studies of diffused guides in lithium niobate and glass substrates. The third task will undertake research in the area of lens design and related areas of geometrical and physical optics. The proposed research involves significant departures from conventional techniques presently used in the optical design process.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0004, CALCULATION AND ANALYSIS OF TRANSONIC FLOWS - STEADY AND UNSTEADY - WITH APPLICATION TO TRANSONIC TESTING

A.R. SEEBASS, Univ. of Arizona, School of Engineering, *Tucson, Arizona* 85721 (DF042730; AF-AFOSR-2954-76)

AF function - advanced aerospace vehicles. Deficiency - lack of basic knowledge on how to calculate forces and moments on two-dimensional and three-dimensional configurations for both steady and unsteady flows that may, or may not, have boundaries simulating tunnel walls. Objective - develop a rapid and efficient method of calculation for steady and unsteady transonic flows. Analyze steady and unsteady small perturbation transonic flows with emphasis in the area of wind tunnel testing problems. How contributes - a better understanding of steady and unsteady transonic flows will enable us to include calculations of this type in the design process. It will also enable us to modify such designs on the basis of wind tunnel measurements.

Specialized computational procedures appropriate to steady and unsteady transonic flows will be further developed and extended to new cases. Topics will include unsteady flow over airfoils, correct accounting for shock motion, extension of shock fitting methods to non-normal shocks, behavior of an expansion-corner flow, flows over swept wings, use of finite elements to calculate mixed flows, and impingement of shock waves on ventillated wind tunnel walls.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0005, LASER-INDUCED FLUORESCENCE SPECTROSCOPY FOR MAKING IN-SITU SPECIES CONCENTRATION MEASUREMENTS IN TURBULENT COMBUSTION FLOWS

J.W. DAILY, Univ. of California, School of Engineering, *Berkeley, California* 94720 (DF049060; AF-AFOSR-3357-77)

AF function - advanced diagnostic techniques, advanced air-breathing engines, weapon delivery and defense. Deficiency - inability to obtain reliable measurement of important parameters in turbulent reacting flows in practical hostile combustion environment via present-day measuring and diagnostic techniques, inability to reliably evaluate combustion models. Objective - to develop sensitive selective, precise, reliable and rapid diagnostic methods for measuring important parameters in jet engine reacting flow environment. To determine feasibility of using laser-induced fluorescence spectroscopy (LIFS) for obtaining high spacial and time resolution in-situ species concentration measurements in practical combustion environments, to determine capabilities and limitations of LIFS as a laboratory diagnostic tool, to provide reliable experimental data to the combustion modeler. How work contributes - will provide additional understanding and reliable data to permit realistic evaluation of analytical models of complex reacting flows, will help reduce development time and cost of air-breathing propulsion systems, will permit evaluation of capabilities and limitations of various diagnostic methods, will aid in development of improved or novel new in-situ nondisturbing techniques for accurately measuring turbulent reacting flow parameters.

Using laser-induced fluorescence spectroscopy techniques, measurements will be made of hydroxyl radical concentrations in two laboratory burners, one laminar and one turbulent. Standard burners will be used wherever possible. Initial work will involve examination of the OH spectrum in both flames, mapping interferences, temperatures, and concentrations using conventional absorption and emission spectroscopy. The OH fluorescence spectrum will then be measured in the laminar flame and saturation and trapping effects examined. Results will be used to optimize the excitation and detection schemes. Data acquisition electronics and signal processing will be developed. The system will be applied to the turbulent flame and fluorescence results compared with those from more conventional measuring techniques. The experimental procedures will be guided by and the results compared with a theoretical model that will be developed to describe the excited state populations of OH. Additionally, theoretical predictions of turbulence results will be made using standard theory for comparison with experimental results.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0006, DYNAMIC SYSTEMS CONTROL THEORY

C.T. LEONDES, Univ. of California, School of Engin. & Appl. Sci., *Los Angeles, California* 90024 (DF042860; AF-AFOSR-2958-76)

AF function - a study in dynamic systems control theory. Deficiency - effective techniques for on-line real time determination of the optimum two-sided controls implied by differential games are as yet undeveloped. Kalman filter techniques have deficiencies attributed to modeling errors and unreasonable systems computational burdens. How work contributes - this research, if successful, would offer new methods for controlling weapons systems.

A profusion of research has been expended in developing techniques for solving the linear optimal control problem of two-sided controls implied by differential game theory, but the extension of this problem to the neighboring optimal control of the bounded control/state case has so far been unsuccessful. A major portion of this research will be expended in the techniques of generalized linear programming for the solution of this nonlinear optimal control problem. The theory of Kalman filtering appears to apply to dynamic systems in a straightforward and powerful way. However, the implementation of Kalman filtering techniques is plagued by the presence of modeling errors and quite restrictive computational burdens. The second portion of this research will deal with modeling errors and the high order of the filtering equations effectively and efficiently as typically apparent in stochastic dynamic systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0007, DIMENSIONALITY REDUCTION CONCEPTS IN STRUCTURAL SYNTHESIS

L.A. SCHMIT, Univ. of California, School of Engin. & Appl. Sci., *Los Angeles, California* 90024 (DF038290; AF-AFOSR-2640-74)

AF function - advanced aerospace vehicle designs require improvements in structural efficiency and weight reductions. Deficiency - structurally optimized designs can lead to extremely sensitive structures under compressive loads with questionable postbuckling strength. Objective - the objective of this research is to develop techniques to rationally reduce the number of design variables and to investigate the question of imperfection sensitivity of an optimal design and the influence of secondary stresses. How work contributes -application of structural optimization techniques can provide more efficient and economical preliminary and detailed structural designs.

The research will utilize a mathematical optimality criteria procedure. Modeling capability will be extended beyond truss structures by incorporating constant triangles and isoparametric quad-8 elements. Stability research will consider both system and member imperfections. These imperfections will be incorporated through nodal position perturbations and deviations from straightness which substantially complicates indeterminate configurations. In addition, the research will investigate the influence of thermal environments on an optimal design and consider residual stresses in composites due to processing conditions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0008, FUNDAMENTAL PROBLEMS IN HIGH-ALTITUDE AERODYNAMICS

E.P. MUNTZ, Univ. of Southern California, School of Engineering, *Los Angeles, California* 90007 (DF014950; AF-AFOSR-3142-77)

AF function - weaponry, propulsion and power, aerospace vehicles. Deficiency - lack of knowledge of vibrational and rotational energy distribution in nonequilibrium expansions from excited states in laser cavities and rocket plumes. Objective - to characterize nonequilibrium nozzle expansion flows of vibra-

tionally and rotationally excited carbon monoxide, to determine the populations of the various quantum levels, and to determine the influence on these observations of the various rarefied plume parameters. How work contributes - this knowledge will be useful in understanding processes in gas lasers as well as in high-altitude rocket plumes.

Vibrational excitation of carbon monoxide is produced by an electrical discharge in specially constructed apparatus. The gas is expanded into near vacuum through a nozzle, and an electron beam is used to determine, by the fluorescence technique, the relative numbers of molecules in the various vibrational rotational quantum states.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0009, FEASIBILITY STUDY OF DEVICE SYNTHESIS OF NONLINEAR FILTERS

W. STEIER, Univ. of Southern California, School of Engineering, *Los Angeles, California* 90007 (DF042580; F44620-76-C-0085)

AF function - Air Force systems for communications, signal processing, navigation, and control need efficient and reliable methods for the separation of the signal from disturbance and noise. In practical signal processing systems, nonlinearity is the rule rather than the exception, and improved signal filtering, estimation, and tracking methods for such systems are definitely needed. Opportunity -means for filtering, estimation, and identification of such signals are mostly based on assumptions of linearity of the system model and Gaussian statistics of stochastic disturbances which frequently lead to inaccurate and undesirable behavior. Objective - this research will study methods for realizing multi-dimensional convolvers in order to build real-time optimal feedback systems which synthesize nonlinear filters. How work contributes - this effort advances filters for use in command and control systems.

Real-time convolvers will be synthesized in two different ways -analog methods employing optical processing, and digital methods employing an array processor. With respect to optical processing, three problem areas will be emphasized - convolution accuracy, interface to digital portion of filter, and division of tasks between digital and optical processors. Work on the array processor will be expended in reducing the memory requirement and the iteration time, and in developing the capability of handling higher order filtering operations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0010, MULTICOMPONENT OXIDE SYSTEMS FOR CORROSION PROTECTION

W.H. STEIER, Univ. of Southern California, School of Engineering, *Los Angeles, California* 90007 (DF048800; AF-AFOSR-3334-77)

AF function - Air Force systems, particularly aircraft, are subjected to a variety of corrosive environmental conditions during their operating lifetimes. To increase reliability and reduce operating costs, improved protective coatings must be developed to minimize corrosion damage. Deficiency - corrosion damage to high-dollar-value equipment costs the Air Force an estimated 250 million dollars per year. Objective - to use a unique approach to the problem of corrosion protection for aircraft aluminum surfaces and to develop and characterize new multicomponent oxide coatings using criteria based on a conceptual model. How work contributes - substantial cost savings to the Air Force will result from improved anticorrosion coatings.

Evaluate the corrosion properties of aluminum oxide/chromium oxide, develop techniques for deposition of multicomponent oxide films, characterize these films by Auger and XPS analysis and evaluate their corrosion resistance.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0011, SATELLITE POSITIVE ION BEAM SYSTEM (SPIBS)

T.D. MASEK, Hughes Aircraft Company, *Malibu, California* 90265 (DF246360; F19628-76-C-0066)

AF function - surveillance or communication satellites. Deficiency - electrical charging of satellites causes failure of on-board electronic components. Objective - development and space flight of a positive ion gun to induce controlled electrical charging. How research contributes - by simulating and controlling satellite charging, the effects on a satellite being charged while in orbit can be determined, and the extent and nature of deleterious effects on electronic equipment can be studied.

A system will be built to enable the controlled ejection of positive ions from a satellite. The system will meet the following specifications- weight less than 10 pounds, beam current greater than 1 milliamp, ion energy greater than 1 keV, operating lifetime greater than 100 hours. The operational period of the ion source will be determined by ground commands. Using this system either positive ion or neutralized beams will be ejected from the satellite. The system will be used on the SCATHA satellite which will be launched in December 1977.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

4.0012, STABILITY, TRANSITION AND MIXING OF BOUNDARY LAYERS AND ADJACENT STREAMS

A. DEMETRIADES, Ford Aerospace & Comm. Corp., *Newport Beach, California* 92663 (DF040120; F44620-75-C-0016)

AF function - air vehicles. Opportunity - improving and defining the performance of many advanced Air Force systems depends heavily on increased understanding of the manner by which supersonic and hypersonic shear flows become unstable and turbulent and of the subsequent mixing of these flows with surrounding streams. Typical of the diverse systems which depend on such an increased understanding are reentry vehicle heat shields and flowing gas lasers. Nose cones for ballistic reentry require better methodology, than now available, for predicting laminar to turbulent boundary layer transition. Transition occurring unexpectedly can cause serious unprogrammed ablative shape changes, warhead malfunction and trajectory dispersion; this effort will investigate the process by which a laminar boundary layer transitions to turbulence at hypersonic speeds. Objective - the objective of this research is to help fill a gap in our knowledge of hypersonic viscous flows by not only making more reliable the laboratory simulation of reentry configurations so that better correlation between theory, laboratory and full-scale data will be possible, but also to provide reliable experimental data on selected aspects of reentry technology. How work contributes - this research is a theoretical and experimental investigation of the way various hypersonic boundary layer instability modes are amplified or damped as the vehicle surface is cooled and/or free-stream disturbances impact on the boundary layer.

A four-degree half-angle cone model will be inserted into the AEDC/B Mach number light wind tunnel at zero angle of attack and surface temperatures ranging from forty to eighty percent of the free stream stagnation temperature. The boundary layer of this model will be probed with fast responding sensors to measure amplitudes and amplification rates as a function of frequency and Reynolds number. The free stream turbulence magnitude will also be measured to determine its dominant mode, the manner by which it contaminates the model boundary layer and the eventual effect of the free stream disturbances in transition.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0013, THE EXPERIMENTAL AND ANALYTICAL DEVELOPMENT OF SENSITIVE SUPERCONDUCTING ACCELEROMETER AND GRAVITY GRADIOMETER

W.M. FAIRBANK, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DF041930; AF-AFOSR-2913-76)

AF function - gravity gradiometer is required to determine the deflection of the vertical along flight path to improve the missile CEP. Deficiency - gravity gradiometers are required to operate with an accuracy of ten to the minus 12 g/m. This is so demanding that closed-loop mode operation will be essential. Although present technology of electronic components has reduced the thermal noise levels within the system to their equivalent Brownian motion, cryogenic techniques will be required to make any significant reduction in the respective noise

levels. Objective - the properties of the accelerometer and gradiometer to be investigated indicate an exciting potential in applications which are presently difficult and beyond the state of the art of existing techniques. The extremely low threshold suggests measuring the gradient in the gravitational field without excessive averaging times. Contribution - inertial navigators are ultimately limited in accuracy by their knowledge of the local gravity field, in particular the tilt of local vertical. Therefore, improved gravity gradiometer will provide the necessary data to determine the deflection of vertical during the flight path or operation.

It is proposed that instrument design limitations and ultimate threshold sensitivity be investigated and experimentally verified.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0014, RESONANCE ABSORPTION SPECTROSCOPY OF COMBUSTION GASES USING TUNABLE INFRARED DIODE LASERS

R.K. HANSON, Stanford University, School of Engineering, *Palo Alto, California* 94305 (EY-76-S-03-0326 PA58)

Recently developed tunable infrared diode lasers will be used to perform high-resolution absorption spectroscopy of combustion gases. A principal objective of the research is to develop tunable laser absorption tehhniques for measuring species concentrations and temperature. Measurements will also be made of fundamental spectroscopic parameters including infrared line strengths and collision halfwidths. Initial work will focus on CO and NO, species of current interest in combustion research.

Experiments will involve passing the laser beam through high-temperature gases produced in a flat burner or a shock tube and subsequently tuning the laser wavelength across isolated vibration-rotation absorption lines, thereby measuring complete absorption line shapes directly. If the species concentration and temperature are known, the aborption data yield important high-temperature determinations of line-strength and collision halfwidth. If these fundamental parameters are already known, then the same measurements can be used to infer the absorbing species concentration and temperature.

Tunable diode lasers are low-power CW devices which emit narrow-linewidth radiation. This narrow linewidth allows orders-of-magnitude improvement in spectral resolution over conventional infrared absorption spectroscopy. Wavelength tuning is accomplished by varying the current passed through the diode. The small size of the laser elements allows fast tuning rates approximately 10 to the minus 3rd power cm to the minus 1st power/micron sec over intervals of 1-2 cm to the minus 1 power. Tunable laser absorption therefore offers prospects for fast, nonperturbing measurements in combustion gases.

SUPPORTED BY U.S. Energy Research & Development Admin., Div. of Basic Energy Sciences

4.0015, OPTICAL DATA PROCESSING AND STATISTICAL OPTICS

N. GEORGE, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DF033720; F49620-76-C-0021)

AF function - electrooptic techniques that drastically improve current intelligence, reconnaissance, detection, signal processing, and communication capabilities are of prime importance to the Air Force. Opportunity - the need exists for theoretical and experimental research to be conducted in modern optics to achieve solutions to important specific problems in the generation, propagation, properties, and uses of coherent electromagnetic radiation. The tremendous information handling capability of optics is the major incentive for seeking a better understanding of optical phenomena. Objective - the proposed effort will contribute solutions to important specific problems which have an underlying significance in future applications of coherent optical systems. How work contributes - this research advances optics for applications in command and control systems.

The topics to be addressed are the effect of wavelength variations on the distribution of light scattered by contoured rough objects, modeling of atmospheric turbulence using a thick diffuser model, laboratory simulation methods for atmospheric speckle, the field distribution near the focus of a system employing a sector aperture, and the deblurring of interferometric images by utilizing the impulse response of the system.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0016, PULSED PLASMA ACCELERATION IN STRONG BIAS MAGNETIC FIELDS FOR ELECTRIC PROPULSION APPLICATION

C.L. DAILEY, Thompson Ramo Wooldridge Inc., *Redondo Beach, California* 90278 (DF044070; F44620-76-C-0107)

AF function - satellite surveillance, communication and navigation, advanced electric propulsion engines. Deficiency - insufficient fundamental understanding of loss processes and acceleration mechanisms in plasma thrusters and lack of experimental data and realistic guidelines for defining capabilities and predicting systems performance. Objective - to understand and develop theoretical and analytical models accurately describing the plasma generation, acceleration and loss phenomena associated with the biased magnetic field-electrode discharge pulsed plasma thruster concept, to obtain critical experimental data to evaluate the analytical models and the concept. How work contributes -will provide additional understanding and realistic analytical modeling of the plasma generation, acceleration and loss mechanisms in the bias field electrode thruster and will contribute to the technology base required for realistic evaluation and development of the concept as an effective simple, compact, lightweight high-thrust and total-impulse plasma space propulsion engine.

Theoretical and experimental studies will be carried out of plasma generation, acceleration and loss mechanisms associated with a quasi-steady biased magnetic field pulsed plasma thruster using an electric discharge or other means for current production. Included will be determination of plasma current distribution in the presence of the applied magnetic field and measurement of efficiency versus specific impulse delivered to the magnetic structure via thrust balance and circuit diagnostics. The acceleration performance will be examined over a range of magnetic field properties, channel shapes, electrode configurations, voltage and gas density. The energy storage and discharge modes will be examined and attempts made to optimize accelerator performance through alterations in the current discharge circuit, geometric or other parameters. Results will be used to develop a physical model describing the plasma properties, acceleration and loss mechanisms and to provide a basis for practical thruster design.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0017, FABRICATION OF SCALED SRM MODELS

W.A. STEPHEN, United Technologies Corp., *Sunnyvale, California* 94088 (DF189240; F29601-77-C-0041)

The objective is to produce a series of ten scaled solid rocket motor (SRM) models to be used in a test program which analyzes structural response of SRMS to earth impact in a launch abort situation. The data obtained from these tests will provide information for engineering studies related to nuclear safety evaluations of current and future DoD orbital/deep space missions.

The motors will be linearly scaled models of the 624A segments, five of which comprise the UA-1205 SRM, the strap-on launch booster for the TITAN III-C. The models will consist of motor casings, liner, and an inert propellant simulant whose mechanical properties duplicate those of the actual UTP-3001 propellant.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Weapons Lab.

4.0018, ERROR DETECTION IN HAL/S PROGRAM

L.D. FOSDICK, Univ. of Colorado, School of Engin. & Appl. Sci., *Boulder, Colorado* 80302 (NSG 1476)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0019, AIRBORNE LASER LABORATORY (ALL) AERODYNAMIC STUDIES

R.F. FELTON, U.S. Air Force, Aeronautics Department, *Colorado Springs, Colorado* 80840 (DF281810)

AF function - counterair. Deficiency - insufficient knowledge exists concerning the flow field associated with the open laser cavity in the airborne laser laboratory (ALL) turret. Research - investigate the flow field which exists downstream of a perforated spoiler in subsonic flow. How research contributes - determines the feasibility of mounting an acoustic screen around the cavity opening to reduce the vibration occurring inside the cavity. Abstract - a question exists as to whether the acoustic screen will create a flow field condition that could impair the propagation of the laser beam. The scope of the work is to conduct a literature search, analyze the previous work found, and conduct appropriate experiments that furnish additional data on the flow field. A literature survey has revealed several works that are relevant to the present study. Preliminary experiments have been conducted at M -0.48 to investigate the flow direction. The flow direction was indicated using flow visualization on the base plate on which the perforated spoiler is mounted.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Frank J. Seiler Research Lab.

4.0020, DEVELOPMENT OF IMPROVED DESIGN METHODS FOR DIGITAL FILTERING SYSTEMS
T.A. BRUBAKER, Colorado State University, School of Engineering, *Fort Collins, Colorado* 80523 (DF100770; F33615-75-C-1138)

To develop improved design methods for linear digital control algorithms which are applicable to digital avionics systems, to evaluate these improved design methods in comparison with conventional design procedures such as the Tustin's method, and to develop interactive software to aid in the design and implementation of ditital control algorithms.

This program will modify the Tustin method to include the sampling interval as a design parameter. Constraining the algorithm coefficients to eliminate or minimize the requirement for digital multiplication leads to algorithms that are simple to implement and thus more reliable. Interactive software will be developed and delivered to aid in the design and implementation of digital control algorithms.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0021, VERIFIERS FOR COMMERCIAL AIRCRAFT APPLICATIONS
W.D. MAURER, George Washington Univ., School of Engin. & Appl. Sci., *Washington, District of Columbia* 20037 (NSG 1472)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0022, SURFACE WAVE DEVICES FOR COMMUNICATION AND CONTROL
D. WEBB, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN480046)

There is a need for improved secure and covert communication systems, for applications ranging from voice communications to remotely piloted vehicles. The objective of this program is to develop advanced state-of-the-art UHF signal processing components for communication systems currently under development.

Surface acoustic and magnetic wave technology will be employed to realize compact, high-performance, low-cost UHF components. Particular emphasis will be placed on components which are capable of realizing a continuously variable phase and/or amplitude.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Electronic Systems Command

4.0023, VOLUME LASER HOLOGRAPHIC INFORMATION STORAGE AND RETRIEVAL FOR TWO-DIMENSIONAL SIGNAL PROCESSING 14487-EL
T.K. GAYLORD, Georgia Inst. of Technology, School of Electrical Engin., *Atlanta, Georgia* 30332 (DA0E9245; DAAG29 76 G0339)

To make an in-depth study of the holographic response of iron-doped lithium niobate to facilitate the use of holographic information storage and retrieval in two-dimensional (2d) signal processing. Relevance -this research is relevant to increasing the speed and memory density and reducing the size of new generations of computers. Large-volume storage and processing of data is relevant to the generation of topographic maps, imagery interpretation, and image processing.

A comparison will be made of the theoretical terminal characteristics of volume phase holograms as predicted by Ninomiya's dynamic hologram theory with experimental results to identify any discrepancies and the exposure range over which the theory applies and to determine the application of the theory to the analysis and synthesis of 2d signal holograms. An experimental study will be made of recording and retrieval of real 2d signals by means of Fourier-transform holography techniques to achieve high-capacity data storage and processing at room temperature and efficient selective alteration of stored data pages for performance of logic operations and parallel processing. Techniques to reduce scattering effects will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0024, GENERALIZED GEOMETRIC PROGRAMMING WITH APPLICATIONS
E.L. PETERSON, Northwestern University, Technological Institute, *Evanston, Illinois* 60201 (DF046350; AF-AFOSR-3134-77)

AF function - the improved use of scarce resources, including funds, manpower, and equipment is an all-pervading responsibility in the Air Force. Deficiency - the best allocation of resources is often an extremely difficult goal to achieve, especially when there are a number of imposed constraints. Such problems arise in structural mechanics, engine/aircraft design, scheduling machine shop jobs, and routing transport vehicles. Objective - to extend the theory of geometric programming, a type of optimization theory that is only 15 years old and which has found a large number of useful applications. How work contributes - research in this area leads to better methods --computationally faster or capable of treating larger problems -- which in turn means higher cost effectiveness.

The theory, whose foundations rest largely on the pioneering work of the proposer, will be extended and applied to problem areas of the following sorts -- 1) optimal location of new facilities relative to existing facilities, 2) nonlinear multicommodity traffic flow, 3) electric and hydraulic networks, and 4) nonlinear multicommodity storage and/or transshipment.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0025, MECHANISMS AND METHODOLOGIES FOR THE DESIGN AND CONSTRUCTION OF COMMUNICATING CONCURRENT PROCESSES IN REAL-TIME ENVIRONMENTS
R.H. CAMPBELL, Univ. of Illinois, Graduate School, *Urbana, Illinois* 61801 (NSG 1471)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0026, CONTROL STRATEGIES FOR COMPLEX SYSTEMS FOR USE IN AEROSPACE AVIONICS
J.B. CRUZ, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DF037410; AF-AFOSR-2570-73)

Air Force function - design of Air Force control systems. Deficiency - the increased demand on the control system to maintain desired performance tends to amplify the undesirable effects of parameter uncertainty or unpredictable parameter change. Objective - the objective of this research program is to develop new methods for counteracting the effects of uncertainties on the control of systems. How work contributes - successful development of these methods would give improved system performance for Air Force systems through more effective control.

Two approaches will be investigated, one regarding system parameters as unknown but deterministic, the other treating the parameters as random. Under the deterministic approach, investigations will include sensitivity models, sensitivity of low-order observers, sensitivity to model order changes, and parameter sensitivity in the polynomial matrix form of system representation. Under the random parameter approach, methods of and related to dual control (where control effort is divided between control and identification) will be considered, as well as a variable structure systems approach first proposed in the Soviet Union.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0027, ANALYSIS OF MICROSTRIP RADIATING ANTENNAS

G.A. DESCHAMPS, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DF901280; F19628-76-C-0140)

AF function - antenna systems for high-speed aircraft, missiles, and aircraft-to-satellite communication. Deficiency - microstrip antennas that use more complex types of radiating elements than a simple slot or a rectangular plate have not yet been fully understood or analyzed. This is a major obstacle to further development and synthesis of new antennas. Objective - analyze microstrip antenna and radiating elements and provide manageable design formulas to allow synthesis of microstrip antennas and feed systems. How research contributes -provides HF antenna engineers techniques and tools to design flush-mounted antennas.

The fields that exist between plates of the microstrip antenna and its coupling to free space will be investigated. Curvature effects of microstrip antennas conformal to irregular surfaces, the interaction between elements and impedance of the various shapes of flat plates and slots will be analyzed and manageable formulas and design criteria determined. Simple experiments will be performed to verify the results of the theory.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0028, INTERNAL & EXTERNAL BALLISTICS OF MISSILES WITH SPECIAL CONSIDERATION OF JET PLUMES INTERFERENCE EFFECTS DURING LAUNCH & FREE FLIGHT PHASES

H.H. KORST, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DA0E9089; DAAG29 76 G0209)

To conduct a comprehensive research program dealing with aerodynamic interference problems encountered during various phases of in-tube propulsive burning and ballistic flight trajectory of rockets. This research is directly relevant to the problem of estimating jet plume effects on performance, stability and control of high-acceleration rockets and missiles. Such problems have been identified as high priority advanced technology areas in the MICOM missile plan. In addition, it is relevant to the research activities at BRL in launch and transitional ballistics.

This program shall include theoretical analysis, computer program development, mathematical modeling, and selected experimentation aimed at establishing the merits of analytical and modeling concepts for jet plume-launcher wall interference, blow-back at breach, muzzle blast, and jet plume-slipstream interference.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0029, INVESTIGATION OF ELECTROMAGNETIC COUPLING THROUGH APERTURES IN CYLINDRICAL STRUCTURES

R. MITTRA, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DN575397; N00014-75-C-0293)

Electromagnetic coupling through apertures into cylindrical structures such as naval aircraft, missiles, and ordnance or coaxial cables is of concern to the Navy in the areas of compatibility of naval electromagnetic systems, electromagnetic interference, electromagnetic pulse protection, and safety of exposed ordnance. This research will develop methods for calculating the amount of such coupling.

Techniques utilizing the method of moments, geometric theory of diffraction, and spectral theory of diffraction will be developed to calculate the electromagnetic field strengths and distribution induced inside a cylindrical cavity by electromagnetic waves incident at arbitrary angle upon single or multiple apertures in the cavity. The current induced on a wire within the cavity will be calculated using a Weiner-Hopf technique to determine reflection coefficients, and Newmann series to calculate the current.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0030, GROUND-REFERENCED VISUAL ORIENTATION WITH IMAGING DISPLAYS

S.N. ROSCOE, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DF049640; F49620-77-C-0117)

AF function - all computer-generated, sensor-generated, and optically generated displays that present synthetic images of the outside world have the common characteristic of producing systematic errors in size and distance judgments. Deficiency - although the correction needed for any given system and for each individual using a system can be readily established empirically by a simple psychophysical experiment, determination of the causes of the constant perceptual errors presents an elusive problem as does the identification and quantification of the independent variables that affect their magnitude. Objective - the research will correlate perceptual and oculomotor responses to variations in the visual scene, specifically in the distribution of resolvable texture surrounding centrally presented target objects, in the performance of tasks involving judgments of size and distance as encountered in flight operations. How research contributes - a complete understanding of variables contributing to biased size and distance judgments and their individual influences would allow general rules rather than specific tests to guide engineers in designing systems. Such understanding would also provide a basis for formulating testable theories of the visual perception of distance.

The technical approach involves the continuing review of current research findings, systematic refinement of a model of the oculomotor functions of the eye that will eventually amount for the host of unexplained findings in the judgment of the sizes and distances of objects in the visual scene, and a program of experimentation to establish quantitative functional relationships among perceptual departures from the law of size constancy and the accommodation of the eye to distances other than that of the object to be judged, as indicated by measuring the curvature of the anterior surface of the lens and subsequently by the use of an infrared optometer. During the later phases of the program, depending on findings from the earlier phases, cortical electrical potentials will be correlated with their associated oculomotor and perceptual responses.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0031, OPTICAL CABLE SYSTEMS FOR NAVAL AIRCRAFT

R.S. KATZ, U.S. Navy, Avionics Facility, *Indianapolis, Indiana* 46218 (DN030051)

To develop techniques to replace avionics systems wiring with fiber optics cables.

The program consists of four phases: (1) a study of optical cable system technology; (2) (a) define system parameters, (b) develop and optimize standard transmitter and receiver circuitry; (3)(a) environmental testing of cables, (b) develop a prototype optical cable system, optimized for aircraft, (c) establish packaging techniques for transmitters and receiver, (d) develop hardware including connectors for aircraft deployment; (4) install prototype cable system for test and demonstration; (5) a handbook for assembly and installation of optical wiring including design information will be prepared.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

4.0032, STUDY OF SURFACE ACOUSTIC WAVE CHARGE TRANSFER DEVICE
H.C. LIN, Univ. of Maryland, School of Engineering, *College Park, Maryland* 20740 (NSG 1468)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0033, PROPAGATION OF SIGNALS THROUGH NONLINEAR, IONIZED MEDIA
R.E. MCINTOSH, Univ. of Massachusetts, School of Engineering, *Amherst, Massachusetts* 01002 (DF039780; AF-AFOSR-2763-75)

AF function - operation of high-altitude vehicles in a post-nuclear explosion environment, development of electromagentic weapons, space and ionospheric communications as well as countermeasures demand the fundamental understanding of interaction of electromagnetic signals and ionized media. Deficiency - the aforementioned information required for the design of advanced equipment is not available today. Its acquisition may be realized by a well planned theoretical and experimental research program. Objective - this research will attempt to understand the effect that plasma inhomogeneity, dispersion, nonlinearity, anisotropy and nondeterminacy have on the propagation of electromagnetic sources and thus obtain data for the design of ionospheric and space communication systems. Contribution - this work is a part of a comprehensive program of plasma research for the development of an X-ray radiation source for simulation of nuclear weapon effects, the development of advanced electromagnetic weapons (laser and particle beams), the development of space and ionospheric communications, and the development of countermeasures.

This project will investigate the following three areas - (a) Emission of gases during microwave breakdown. Since the plasma generated during breakdown does not satisfy the assumption of local thermodynamic equilibrium or the corona discharge model a new model will be developed. An attempt will be made to model the various physical mechanisms (such as Bremsstrahlung radiation, electron-ion recombination and collisional excitation) to establish relationships between the various parameters of the system. This will be followed by experiments to justify and prove the validity of the foregoing model. (b) Effect of plasma fluctuations on electromagnetic pulse transmission, namely the investigation of the random effects suffered by pulses transmitted through a fluctuating dispersive medium. Experiments will be performed in the 12 cubic meter vacuum vessel in which a pulse will propagate through a suitably ionized medium. Both interferometer and diagnostic probes will be used to measure the statistics of the index of refraction along the propagation path. (c) Channel modeling of the ionosphere for digital transmission. They will study the effects of spatial and temporal variations of the electron density in the ionosphere, the transmitter receiver separation and operating frequency on th (Text Truncated - Exceeds Capacity)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0034, STOCHASTIC AND ADAPTIVE SYSTEMS
M. ATHANS, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF047360; AF-AFOSR-3281-77)

AF function - develop models and control systems for aircraft systems and their subsystems. Deficiency - the control of future aircraft that operate in a diverse environment. Objective - the objective of this proposal is to design stability augmentation systems and control systems that operate reliably over a wide operating envelope. How work contributes - success in the pursuit of this objective would enable engineers to design more accurate and more reliable controllers for use in important Air Force aircraft systems.

The problems of stochastic and adaptive systems will be investigated through five areas of research. The first area deals with modeling and realization theory for stochastic systems. A fundamental contribution of this work will be correct definitions of stochastic reachability and stochastic observability. The second area will be concerned with identifiability and detectability of stochastic processes with application to dynamic system identification. The third area will be the studies in the nonlinear filtering theory of optimal and suboptimal estimations for systems possessing special algebraic structure and the optimal estimation for systems with time delays. The fourth area of research will be the extension of the geometric theory of linear multivariable control to stochastic situations. This research will be applied to stochastic control laws implemented by finite-state sequential machines, singular stochastic control problems and dual compensator structures, and stochastic control of coupled systems. Finally, the last area of research will be adaptive stochastic control with a long-range goal of attempting to combine the robustness results with the white-noise results so as to obtain at the very least some bounds on the improvement in performance by adaptive control, which would serve as a basis for dual control suboptimal adaptive control algorithms with less stringent computational requirements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0035, WIND TUNNEL SHOCK STUDY
M. FINSTON, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF247430; F19628-76-C-0185)

AF function - communication and radar survivability of Air Force systems such as the B-1, AABNCP, AWACS, BMEWS, OTH-B and DSP under naturally disturbed and nuclear environments. Objective - to determine shock wave effects on d-region ion composition measurements. How research contributes - information on shock wave position relative to the measurement probe will confirm a payload geometry for obtaining reliable d-region data which is relevant for communications and radar survivability studies.

An investigation, including wind tunnel measurements, will be made to determine shock wave position as a function of Mach number and angle of attack to determine attached shock conditions (areas of reliable data acquisition) and detached shock conditions (isolating problem areas in data acquisition).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

4.0036, DEVELOPMENT OF ELECTROMAGNETIC MASS DRIVERS
H.H. KOLM, Mass. Inst. of Technology, Graduate School, *Cambridge, Massachusetts* 02139 (NSG 3175)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0037, TURBULENT BOUNDARY LAYER STRUCTURE AND DRAG REDUCTION
M.T. LANDAHL, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF039310; AF-AFOSR-2730-74)

AF function - aerospace vehicles, propulsion and power. Opportunity - in the design of turbine engines, air intakes, lifting surfaces, and aerodynamic shapes which require information on heat transfer, drag, and pressure fluctuation, it is necessary to predict and understand the structure of turbulent fluid flow. Unfortunately, turbulence remains one of the more vexing problems in fluid dynamics and its technical applications. This research proposes to further develop and explore the consequences of a new dynamical model of the fluctuating velocity field in a turbulent boundary layer first proposed by Professor Landahl. If successful, the model should be a major contribution in predicting and unravelling the mechanics of turbulent flow. Objective -to further develop a new dynamical model of the fluctuating velocity field in a turbulent boundary layer using as the cornerstone of the model a wave theory for secondary breakdown of a laminar flow developed by Landahl. How work contributes - statistical theories of turbulence have been found to not be able to explain transport and other observed phenomena. In fact, recent observations indicate that there may be more ordered structure underlying turbulence than

implied in statistical approaches. One of the more promising developments in modeling turbulence has been the recent model of wave breakdown offered by Landahl. It is proposed to use this wave theory of secondary breakdown as a cornerstone for a new dynamical theory of turbulence. If successful, the new theory should also help drag reduction by additives, compliant walls, etc., and also point the way to control of turbulence.

Purely theoretical kinematic wave theory is used to identify conditions of criticality under which waves of small scale focus on larger scale non-homogeneities and grow rapidly to very large amplitudes leading to observed turbulent structure and character. This wave theory includes nonlinearity, dispersion and the possibility of discontinuities in the flow. Spectral characteristics of the large-scale fluctuating velocity field are obtained by direct numerical integration of an inhomogeneous Orr-Somerfeld equation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0038, FAR INFRARED AND SUBMILLIMETER TECHNOLOGY 13987-P

P.E. TANNENWALD, Mass. Inst. of Technology, Lincoln Laboratory, *Lexington, Massachusetts* 02173 (DA0E9268)

To investigate and improve submillimeter detection technology, particularly Schottky diode detectors, techniques for matching the signal radiation with the local oscillator, and to explore various sources as local oscillators. Relevance - this research is an important part of the Army's program to develop submillimeter wave technology for remote sensing that may operate under inclement weather, cloud, or countermeasure smoke environments.

Research will be conducted in the following areas: (1) improvement of current diodes, (2) detectors using all-planar fabrication, (3) modified h-guide mixer, (4) three-dimensional integrated local oscillator and detector, and (5) hybrid Impatt local oscillator-mixer configuration.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0039, GUIDANCE AND CONTROL UNIT FOR THE SMART PARACHUTE AIRDROP SYSTEM (SPADS)

W. NYKVIST, U.S. Army, Natick Research & Dev. Command, *Natick, Massachusetts* 01760 (DA0H4174)

Develop a guidance and control unit for gliding parachute application. Hardware for precisely managing the free flight and terminal state of an unpowered slow-speed vehicle will be developed.

Design breadboard hardware in accordance with theoretical treatments which have identified control laws capable of providing the desired trajectory management capabilities.

SUPPORTED BY U.S. Dept. of Defense, Army, Natick Research & Development Command

4.0040, ELECTRICAL CHARACTERIZATION OF SEMICONDUCTOR MICROPROCESSOR DEVICES

P. BURKE, General Electric Company, *Pittsfield, Massachusetts* 01201 (DF737380; F30602-77-C-0012)

The objective of this effort is the develop guidelines for the electrical characterization and testing of semiconductor microprocessor devices. Specific types will be thoroughly characterized and the resulting data used to prepare a detailed M38510 specification.

This will include a detailed static, dynamic, and functional analysis of the various logic arrangements within and between the various microprocessor configurations. Important features, limitations, and interchangeability criteria will be determined and compared according to established trade-offs such as power-speed, temperature-frequency, etc. In addition, special test methods for characterizing microprocessors will be developed and reported in a format compatible for use in MIL-STD-883. This effort will develop general knowledge regarding the optimum electrical test conditions for special microprocessors, and provide criteria for specifying critical electrical parameters for use in government-prepared MIL-M-38510 specifications.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0041, AERODYNAMIC PARAMETER AND STRUCTURE IDENTIFICATION FROM FLIGHT TEST

C. BROWN, Analytic Sciences Corporation, *Reading, Massachusetts* 01867 (DF641980; F08635-77-C-0062)

Development efforts in air-launched missiles require low-cost nondestructive testing of missile and hardware performance of total system. This type of testing is achieved by simulation. This work unit will increase simulation accuracy while reducing manpower expenditure, by providing a means of updating simulation aerodynamics via flight test results.

Past methods of updating missile aerodynamics have been unsatisfactory and time consuming. This approach will perform a 'backwards' simulation (i.e., given missile trajectory, determine the required simulation for flight matching). The method will be mechanized by forcing the missile equation of motion as observed in flight into a set of simulation coefficients. To do so will make use of available flight test instrumentation errors so that a high level of confidence can be achieved.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Armament Lab.

4.0042, SURVEILLANCE - WEATHER DOPPLER LASER

A. JELALIAN, Raytheon Company, *Waltham, Massachusetts* 02154 (DN575047; N00014-75-C-0282)

The objective of this research is to apply optical Doppler techniques to a determination of the power distribution vs. wind eddy sizes in the atmosphere. The distribution of these eddies is expected to aid the naval capability in short-range weather predictions and in predicting the performance of electrooptically guided weapons systems.

Existing laser equipment has been modified to determine the distribution of wind eddy sizes under various weather conditions including those preceding arrival of cold fronts, gust fronts, or storms. CW Doppler radar will be used initially to determine eddy sizes and buildup or decay of turbulence with time.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0043, SELECTED PROBLEMS IN SYSTEM ENGINEERING

W.A. PORTER, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (DF035350; AF-AFOSR-3160-77)

AF function - to analyze, design and synthesize electronics systems and aerospace vehicles. Deficiency - complex system engineering problems are continually encountered as a result of using system level approach to obtain maximum mission effectiveness in Air Force aerospace vehicles and support equipment, and as a result of integrating subsystem technology advances. Due to the complexity of the systems and of the appropriate theory available today, the problems are extremely difficult to solve. Objective - to improve the capability to handle these problems by providing a new and more powerful framework for engineering analysis and design. How work contributes - advances in the general theory of nonlinear operators will permit the design and construction of more powerful and cost-effective systems.

Research will continue into the diverse types of causality exhibited by models, into the class of systems represented by polynomic operators, and into the problem of approximating arbitrary causal systems by operators of a simpler type, such as polynomic.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0044, MIXED MODE FRACTURE OF GRAPHITE EPOXY COMPOSITES

D.H. MORRIS, Mississippi St. University, School of Engineering, *Mississippi State, Mississippi* 39762 (DF044290; AF-AFOSR-3058-76)

AF function - advanced aerospace flight vehicles require primary structural systems with improved efficiency and damage tolerance. Opportunity - advanced composite materials hold the potential for application to primary structures with the desired performance increases. Objective - the objective of this research is to investigate the fracture strength and damage growth of graphite-epoxy specimens under mixed mode conditions. How work contributes - this research contributes to overall Air Force R and D program in developing and resolving uncertainties connected with applying advanced composites to structures.

Basic approach planned by this research is experimental. Preflawed specimens under remote tension will be tested to study fracture strength and crack growth characteristics. Two angle ply layups are planned for specimens to be tested. Cracks placed in specimens will have angularity changes with respect to loading axis in 15 degree increments, thus giving mixed mode conditions at crack tip.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0045, SOLID-STATE IMAGE DEVICE PARAMETER STUDY

J.W. ROGERS, Mississippi St. University, School of Engineering, *Mississippi State*, *Mississippi* 39762 (DF043890; AF-AFOSR-3022-76)

AF function - the advent of charge transfer and injection devices has opened the way for the development of low-cost, lightweight, and small-size sensor arrays for Air Force surveillance, reconnaissance, and control systems. One of several areas of semiconductor electronics in which solid state arrays will have a major impact is imaging. Opportunity - solid-state imaging is attractive due to the elimination of the electron-beam scanning mechanism and high-voltage vacuum technology of conventional vidicons. The small size and low power requirements indicate that both linear and area imaging devices will have a strong impact tracking where limited space and power availability are factors. However, several trade-offs must be examined to evaluate the performance and establish the practicality of employing these devices as tracking sensors. Objective - the proposed effort will investigate the interrelationship of tracking parameters as they relate to solid-state imaging devices. The parameters to be considered are: scan rate, target background intensity, target contrasts, inherent noise, fixed pattern noise, and target velocity. How work contributes -research advances image sensors for target acquisition and strike.

An intensive literature search into the performance of the imaging devices will precede an experimental analysis using data obtained from the Air Force Avionics Laboratory.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0046, EXPERIMENTAL STUDY OF SIMPLIFIED AIRCRAFT MODELS AND ADVANCED MEASUREMENT TECHNIQUE DEVELOPMENT

B.M. DUFF, Univ. of Mississippi, School of Engineering, *University*, *Mississippi* 38677 (DF041770; AF-AFOSR-2862-75)

AF function - the study of EMP effects on Air Force systems is very important to the assessment of the survival of these systems in a nuclear environment and to establish hardening procedures. One method of simulating EMP effects is to model aircraft with simple configurations of wires and cylinders. It is important to treat theoretical problems with such configurations as approximations to real systems and also to carry out baseline experiments to check the theory. Deficiency -rigorous analytical solutions for the EMP induced currents on the conducting surfaces of aircraft are not yet available. This work is to pursue some aspects of this problem. Objective - the previous work on thin wires will be extended for the construction of and the measurement of the current and charge distribution on electrically thick structures. Contribution -measured current and charge distributions covering a range of electrical sizes from thin wires to very thick cylinders will assist in the theoretical development of EMP analysis. This empirical approach will provide a complement to theoretical work in the area. The thrust of this effort will be to extend previous work to electrically thick cylindrical structures containing junctions.

Previous work on moderately thin structures has indicated the need for careful experimentation on thicker structures. The first structure to be studied will be the 90 degree cross consisting of electrically thick cylinders of equal radii. The length of the arms will be chosen to include both resonant and nonresonant conditions. The second structure will be a 90 degree cross consisting of a thick cylinder with a flat rectangular strip as a cross member. The charge and current distributions will be measured on these structures as a function of position on the surface. Since the transverse dimensions of the structures are electrically large, the current will consist of both axial and transverse components. It is essential that probe transport mechanisms not disturb the electrical continuity of the surface. Particular attention will be given to the experimental test techniques.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0047, AN INVESTIGATION OF TURBULENT MIXING IN THE CHEMICAL LASER USING HOLOGRAPHIC IMAGERY 13224-E

C.R. WIMBERLY, Univ. of Mississippi, School of Engineering, *University*, *Mississippi* 38677 (DA0X5572; DAAG29 76 G0044)

To perform a systematic experimental and analytical investigation of the turbulent mixing region in a two-dimensional chemical lasing cavity by means of a holographic optics system. Chemical lasers are a leading candidate for a high-energy laser weapon system. The proposed effort will help unravel the behavior occurring in the laser cavity during operation and promote the design of optimized chemical lasers for systems applications.

Schlierens, shadowgraphs and interferograms will be constructed from holograms of the chemical laser cavity and utilized in defining the chemical laser flow structure. Analytic models will be improved based on this experimental information and utilized to determine the sensitivity of laser operating conditions on flow field turbulence and mixing phenomena of parallel supersonic streams.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0048, INHERENT ERRORS IN ASYNCHRONOUS DIGITAL FLIGHT CONTROLS

C.R. SLIVINSKY, Univ. of Missouri, School of Engineering, *Columbia*, *Missouri* 65201 (DF043050; AF-AFOSR-2968-76)

AF function - analyses of monitoring algorithms for detecting failures in Air Force flight control systems. Deficiency - in order to achieve required reliability, redundant computers are used to control critical loops in flight control systems. The techniques used to detect failures in any of the multi-computer loops have not been satisfactorily investigated. Objective - the objective of this research is to devise, model, and evaluate alternative algorithms for monitoring and voting on redundant input signals and redundant control-signal computations in asynchronous, redundant flight-control systems. How work contributes -success in the area of research will facilitate the entry of modern digital control systems into the active Air Force inventory.

This research will be divided in three different areas. The development of algorithms of monitoring and voting will be the first major task. To some extent this task can be considered as an isolated problem, independent of the fact that the monitoring and voting take place in a closed-loop, real-time system. The second major task is the assessment of the effect of the monitoring and voting algorithms on closed-loop, dynamic performance. The capability to study system performance in the presence of malfunctions will be incorporated by appropriate modifications of previously defined models. In addition, software will be developed which will allow a user to apply the above derived algorithms to existing Air Force digital control systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0049, COMMUNICATIONS - COMPOUND SEMICONDUCTOR SURFACES
P. MARK, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DN575093; N00014-75-C-0394)

Surface-oriented semiconductor devices are finding increased usage in naval systems for communications, surveillance, guidance, and control. This program is concerned with the microscopic surface properties of semiconductors that affect the formation of thin-film overlayers or surface reaction kinetics.

The effects of bulk doping and surface crystallographic index and structures, surface composition and topography will be studied through a combination of LEED, AES, SEM, conductivity modulation, and ellipsometric analysis. Studies of the growth of overlayers in GaAs, InP, and II-VI semiconductor systems will be carried out.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0050, MASS DRIVER DEVELOPMENT
G.K. ONEILL, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (NSG 3176)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0051, A THREE-DIMENSIONAL STUDY OF FIN-INDUCED SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTIONS 14026-E
I.E. VAS, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DA0E9174; DAAG29 76 G0269)

To more thoroughly investigate the scale of the interaction between a shock wave from a sharp leading edge generator and a turbulent boundary layer on a flat plate by changing the boundary layer thickness using unswept and swept leading edge flat plates. The research is relevant to activities at BRL and other Army laboratories concerned with designing fin-stabilized anti-tank projectiles and fin-stabilized long-range missiles.

An experimental study will be conducted in the Mach 3 high Reynolds number supersonic facility of the contractor by examining large-scale effects of the boundary layer in the interaction region and measuring heat transfer for a thin boundary layer configuration.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0052, OPTICAL TECHNIQUES
E.A. BLANKINSHIP, U.S. Air Force, Weapons Laboratory, *Albuquerque, New Mexico* 87117 (DF173980)

To provide laser diagnostics for high-power infrared pulsed and continuous lasers. To provide short and ultrashort pulse high-power lasers for experiments in plasma study, damage testing and component evaluation. To provide optical technology support to other AFWL organizations.

To develop and demonstrate pulsed laser and high-power continuous laser beam diagnostics. Laser characteristics such as intensity profile beam divergence and total energy will be measured, displayed and recorded. Short pulse Nd-glass and Nd-YaG lasers will be maintained for experiments including necessary laser diagnostics.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Weapons Lab.

4.0053, MODELING OF HIGH CURRENT INJECTION INTO BIPOLAR SEMICONDUCTORS
E.O. FULLER, U.S. Air Force, Weapons Laboratory, *Albuquerque, New Mexico* 87117 (DF188420)

The objective of this work is to debug a computer code used for modeling high current injection into bipolar semiconductors.

Utilizing top-down techniques, the computer code will be debugged using data for which the resulting answers are known. Once this has been done, the code will be used for predicting the response of actual devices.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Weapons Lab.

4.0054, TELEMETRY SYSTEMS
UNKNOWN, New Mexico State University, Graduate School, *Las Cruces, New Mexico* 88001 (NAS 6-2863)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0055, NOVEL CHEMICAL LASER SYSTEMS
T.A. COOL, Cornell University, School of Engineering, *Ithaca, New York* 14850 (DF047880; AF-AFOSR-3258-77)

AF function - future Air Force operations in reconnaissance, communications, weaponry, and other areas require advances in laser systems of varied output frequencies and shorter wavelengths. Deficiency - there is a lack of a visible, chemically-pumped efficient laser system to satisfy these functional requirements. Objective -perform research on metal atom plus oxidizer reactions to produce electronically excited states with chemiluminescence in the visible and ultraviolet. Evaluate the HCN system as a possible alternative to DF chemical laser operation. How work contributes - attempts to discover visible chemiluminescent reactions of high photon yield and long lifetime that can lead to the development of new chemical lasers.

Employ shock tube techniques to produce shock-induced supersonic flow for the production of electronically excited states of ScF and YCl by reactions of the metal vapors with the halogens. Measure spontaneous emission from these excited states and attempt to achieve laser operation. In a relatively smaller effort examine the feasibility of producing a CW chemical HCN laser at 3.85 microns by studying chemical reactions and molecular energy transfer in the systems H2-HCN, Hf-HCN and DF-HCN.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0056, AERODYNAMIC PROBLEMS OF LARGE-SCALE COOLING DEVICES
F.K. MOORE, Cornell University, School of Engineering, *Ithaca, New York* 14850 (ENG76-02516 A01)

This basic study on dry cooling systems will be in part concerned with the viscous flow in an infinite stack of zig-zag plates intended to represent a yawed heat-exchanger array. In particular, various corner configurations will be investigated and heat transfer rates in corner regions will be predicted. A different but related approach to the yawed heat exchanger problem will emphasize the limit of high drag. Classes of devices intended to accomplish reversible turning at 'bundle' entrance, and irrotational flow at bundle exit will be studied. A general concept for best arrangement of heat exchanger bundles in a cooling-tower entrance will be developed, based on smooth bell-mouth entrance flow, and studies of wind-generated swirls in tower entrance flows, already begun, will be completed. More elaborate studies on exit flow will be undertaken in a wind tunnel and a water tank with a travelling jet. Also considered will be innovative flow devices, such as external ring airfoils, for the control of aerodynamic nonuniformities. This will be a continuation of NSF Grant No. ENG 76-02516.

SUPPORTED BY U.S. National Science Foundation, Div. of Engineering

4.0057, ANALYSIS OF TURBULENT COAXIAL FLOW WITH INTERNATIONAL ENERGY GENERATION
H. WEINSTEIN, City University of New York, Graduate School, *New York, New York* 10031 (NSG 3174)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0058, LASER PELLET PLASMAS FOR THE DEMONSTRATION OF X-RAY LASER ACTION

M.J. LUBIN, Univ. of Rochester, School of Engin. & Appl. Sci., *Rochester, New York* 14627 (DF026400; AF-AFOSR-3189-77)

AF function - operation of high-altitude vehicles in a post-nuclear explosion environment, development of electromagnetic weapons, space and ionospheric communications as well as countermeasures demand fundamental understanding of energy transformation processes occurring in plasmas such as X-ray lasing media. Deficiency - the aforementioned information required to design advanced equipment is not available today. Its acquisition may be realized by a well planned theoretical and experimental research. Objective - this project will investigate both theoretically and experimentally the fundamental characteristics of energy transformation processes. It will specifically study various X-ray lasing media, namely, concentrate on 3P-3S transitions in carbon-like ionization states of elements in the vicinity of argon, in the periodic table. Contribution - this work is a part of a comprehensive program of plasma research for the development of an X-ray radiation source for simulation of nuclear weapon effects, the development of advanced electromagnetic weapons (laser and particle beam) the development of space and ionospheric communications and the development of countermeasures.

This project will perform theoretical and experimental work to understand the energy transformations processes occurring in X-ray lasing media. They will perform experiments to demonstrate gain on 3P-3S transitions in carbon-like ions excited in a laser-produced plasma. Single laser pulses of 10 joules will be focussed by a cylindrical lens onto a solid target surface of a suitable material. The preliminary studies will be on plasmas formed from targets composed of elements in the vicinity of argon on the periodic table, e.g., LiCl, KCc, CAc12, CaS04. They will measure the angular distribution of the emission line spectrum from the plasma. They will employ two vacuum ultraviolet grating spectrographs. Again the pulse width of these experiments corresponds to the one found from the numerical modeling.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0059, IMPROVEMENT OF GAAS CRYSTAL QUALITY

W. TANTRAPORN, General Electric Company, *Schenectady, New York* 12305 (DF049240; F49620-77-C-0105)

AF function - microwave solid-state electronic devices are essential components of Air Force surveillance, electronic countermeasure, and communications systems. Deficiency - the performance of GaAs microwave devices is being limited by the poor quality of the GaAs substrates used in the epitaxial growth process. The high defect density of these substrates causes high noise in microwave field effect transistors and possible complete failure in Impatt devices. Objective - the objective of this research is to develop a method of growing GaAs boules which will consistently and uniformly yield GaAs substrates of a quality superior to that now available. How work contributes - an improved substrate material will allow GaAs microwave devices to achieve higher performance levels than those now possible and thus enhance Air Force systems employing these devices.

The main idea behind this research lies in the fact that most GaAs substrates available today are grown by methods, Bridgman or Czochralski techniques, in which the liquid-solid interface is liquid-convex. This configuration leads to defect migration from the surface into the bulk of the ingot and hence concentrates the number of defects in the main part of the boule. In addition, since solid GaAs is less dense than the liquid, the liquid-convex surface results in high compressional strain, another defect source in GaAs. In this research temperature gradients from a specially designed furnace will be used to control the liquid-solid interface and obtain a solid-convex surface. This interface shape will help to propagate defects out of the bulk and also aid in the reduction of possible elimination of compressional strain. The defects of slices in the boule will be determined by etch-pit density counts. The etch-pit density will be correlated with various radii-of-curvature for the solid convex surface.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0060, WALL INTERFERENCE IN TRANSONIC WIND TUNNELS

P. BARONTI, General Applied Sc. Labs. Inc., *Westbury, New York* 11590 (DN223250; N00014-76-C-0149)

The design of aircraft and missiles for optimum performance at transonic speeds depends critically upon experimental data obtained in transonic wind tunnels. Furthermore, the requirement of high Reynolds number data invariably means large model size, a condition which leads to large wind tunnel wall effects of unknown magnitude which seriously degrade the data. The purpose of this research is to develop an understanding and a procedure for the use of experimental measurements for significantly reducing wind tunnel wall corrections at transonic speeds.

At transonic speeds the porous or slotted geometry of wind tunnel walls makes the accurate determination of corrections, due to the finite domain of the flow, exceedingly difficult. As yet, there is no accurate method for making such a determination, particularly at the higher Mach numbers. The present approach will examine the use of experimental measurements in the flow field for controlling the flow at the tunnel walls and hence reducing the wall effects.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0061, FATIGUE RESISTANCE CRITERIA FOR LAMINATED COMPOSITE STRUCTURES 12825-E

G.J. DVORAK, Duke University, School of Engineering, *Durham, North Carolina* 27706 (DA0H5573; DAAG29 77 G0113)

To study analytically and to verify experimentally the fatigue strength of composites under cyclic mechanical and thermal loads. As pointed out by one of the Army laboratory reviewers, composites are the key to the development of lightweight, high-performance weaponry and the most important factor in such materials is their fatigue performance, particularly low cycle fatigue. This applies particularly to helicopter structures.

Analytical methods will be used in the solution of the thermoplasticity and shakedown problems, avoiding whenever possible excessive numerical solutions. Among these methods will be (a) classical thermoplasticity theory, (b) finite-element techniques, (c) mathematical programming for shakedown analysis, (d) extension of previous techniques to elastic-plastic laminates. These methods and experimental studies will be made on 0-90, 0 plus or minus 45, 0 plus or minus 60 deg. laminates for boron-aluminum, graphite-aluminum, and graphite magnesium systems.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0062, ANALYSIS AND NUMERICAL SOLUTION OF THREE-DIMENSIONAL VISCOUS FLOW PROBLEMS

K.N. GHIA, Univ. of Cincinnati, School of Engineering, *Cincinnati, Ohio* 45221 (DF046990; AF-AFOSR-3191-77)

AF function - advanced aerospace vehicles and air-breathing propulsion systems. Opportunity - improve our understanding of three-dimensional internal viscous flows. Objective - develop a finite-difference numerical technique suitable for solving three-dimensional internal viscous flow problems involving cross flow separation. How work contributes - provides a method which could be used to study flow through inlets with longitudinal and transverse curvature effects.

A finite-difference numerical technique will be developed using the parabolized Navier-Stokes equations. For flows involving complex geometries, the method will employ surface-oriented coordinates. An optimized alternating directional implicit scheme will be employed in order to lead to an efficient solution technique.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0063, EXPERIMENTAL STUDIES OF PLASMA RADIATION SOURCES

O.K. MAWARDI, Case Western Reserve Univ., School of Engineering, *Cleveland, Ohio* 44106 (DF029290; AF-AFOSR-2806-75)

AF function - operation of high-altitude vehicles in a post-nuclear explosion environment and development of electromagnetic weapons, space and ionospheric communications as well as countermeasures demand the fundamental understanding of nonequilibrium plasma processes. Deficiency - the aforementioned information required for the design of advanced equipment is not available today. Its acquisition may be realized by a well-planned theoretical and experimental research program. Objective - this program will investigate the temperature histogram of a dense plasma focus from X-ray spectroscopic measurements. Contribution - this work is a part of a comprehensive program of plasma research for the development of an X-ray radiation source for simulation of nuclear weapon effects, the development of advanced electromagnetic weapons (laser and particle beam), the development of space and ionospheric communications, and the development of countermeasures.

This project will perform experiments by using the developed spectrometer to measure the temperature and density evolution of the plasma produced by a plasma focus during the compression phase of the plasma. The proposed procedure is (a) the X-ray produced by the DPF is directed toward the monochrometer and then analyzed, (b) the output from the monochrometer is channeled to an electronic storage system which stores the signal, (c) the output is substantially displayed in an oscilloscope operating at a slower rate to permit its analysis, (d) from the corresponding equations the temperature and density evolutions with time are found.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0064, INFLUENCE OF STOICHIOMETRY ON THE RAIN EROSION OF CERAMIC WINDOWS

R.G. HOAGLAND, Battelle Memorial Institute, *Columbus, Ohio* 43201 (DF048220; AF-AFOSR-3283-77)

AF function - aircraft and missile operations are highly dependent on electromagnetic windows necessary for the transmission and reception of signals for navigation, target acquisition, target designation and communications. Deficiency - the vehicles must perform at high velocity in adverse weather where rain erosion of the exposed window is a serious problem. Objective - the objective of this work unit is to study the influence of stoichiometry on the rain erosion of ceramic windows. How work contributes - decreasing the surface erosion on windows will significantly improve the accuracy, sensitivity, and detectability of the electrooptical systems.

The approach is to investigate in detail the specific mechanisms of surface layer deformation produced by high-velocity liquid droplets for several binary alloys whose mechanical properties can be systematically varied through control of compound stoichiometry. Materials to be studied include PbS, ZnSe, and ZnS. Liquid drops of silicone oils and mercury will impact the samples at a relative speed up to 680 m/sec (Mach 2).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0065, SEPARATED FLOWS ON AIRCRAFT AND MISSILE CONTROL SURFACE AT SUPERSONIC SPEEDS

O. BURGGRAF, Ohio State University, School of Engineering, *Columbus, Ohio* 43212 (DN223002; N00014-76-C-0333)

The effectiveness of naval aircraft and missile control surfaces at supersonic speeds can be, in general, increased by minimizing the effects of flow separation. Such separation is caused by the adverse pressure gradients induced, for example, by deflected flaps. This research will be a combined numerical-analytical effort to clarify the essential physical processes in separated and reattaching flows.

Flow separation and reattachment on surfaces is an extremely complex phenomenon which can, at this time, be described only by detailed experiments or possibly numerical calculations for each specific case. In an attempt to understand better the physical processes, which are important in many more general situations, a combined analytical-numerical approach will be undertaken. The analytical approach will rely primarily on the high Reynolds number triple-deck asymptotic model. Both two- and three-dimensional separation bubbles will be studied.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0066, EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS OF PHENOMENA CONTROLLING HYPERTHERMAL HEATING TECHNOLOGY

E.G. BROWNEDWARDS, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF138510)

To reduce the cost of strategic missile development, accurate empirical data from ground test facilities is necessary. Demands for increased facility capability in terms of pressure and enthalpy have resulted in a new advanced constricted arc heater. The accuracy with which predictions on flight performance of a thermal protection system can be made depends greatly on knowing the characteristics of the ground test facility. The objective of this effort is to determine both experimentally and theoretically the flow properties of the high-enthalpy gas flow from the constricted arc heater and in addition to study nose tip transition on reentering missiles.

Experimental studies will be made using techniques developed under work unit 19880109. These will include swept null-point calorimeters, swept pressure probe, transient and steady-state enthalpy probe, and an optical line ratio technique. New methods may be necessary to compensate for the increased performance of the constricted arc heater. Additional studies will be made on the variation of heating rate with model nose radius to see if similar trends are found to those in the previous N-4 heater. Preliminary studies will be initiated on the influence of surface roughness on nose tip transition using roughened calorimeters and ablation models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

4.0067, AVSAIL ENGINEERING SUPPORT

P. HOSKINS, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF106490)

The objective of this work unit is to provide for general facility development and purchase of general-purpose test equipment and supplies.

The approach is to identify equipment/supplies of general use to any/all in-house projects and purchase under this work unit. Also, general facility work that cannot be identified against other specific work units is charged to this work unit.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0068, MEMORY TECHNIQUES

F.L. SCHUERMEYER, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF093950)

The objective of this in-house development effort is the test and evaluation of all types of memory devices, such as metal-nitride-oxide-semiconductor (MNOS), charge coupled devices (CCD), and magnetic bubble mass memories. Degradation phenomena, margins, parameter variation with temperature and operating conditions, signal to noise levels error rates, lifetime, timing diagrams, etc., shall be investigated. Typical devices from commercial vendors and Air Force developmental contracts shall be evaluated. This work is necessary to confirm contractor claims and provide guidance and consultation to system project offices. This effort will also be directed toward upgrading the MNOS technology.

Special exercises will be used for MNOS, CCD and magnetic bubble memory tests and evaluation studies. Commercially available macrodata 100 and 104 memory testers shall be used for data pattern sensitivity and other array tests. These facilities will be utilized to test critical performance parameters for comparison to contractor's data. Interface and insulator doping will be developed to improve write speed and endurance of MNOS transistors.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0069, RECEIVER CONCEPT AND EVALUATION
J.B. TSUI, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF097990)

The in-house capability to be established under this effort will provide a much-needed service to the operational commands deploying EW receivers and to the exploratory and advanced development programs attempting to advance the state of the art. Specific objectives include the capability to evaluate and calibrate passive receiver systems operating from 50 mHz to 40 gHz and to define standards which will support systems under development. In addition, new concepts developed by laboratory engineers and contractors will be evaluated and demonstrated under the program.

In-house laboratory equipment will be acquired (through purchase and use of existing equipment identified in other divisions) and integrated into a semi-automated capability. Initial work will emphasize the frequency ranges that existing equipment provides, resulting in minimal new purchase of equipment. As experience is gained in measurements, the program will expand to new concept evaluation and demonstration.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0070, PROPERTIES OF THE MULTIVARIABLE NYQUIST ARRAY METHOD
G.G. LEININGER, Univ. of Toledo, School of Engineering, *Toledo, Ohio* 43606 (NSG 3171)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0071, RESEARCH ON INELASTIC/PLASTIC MECHANISMS IN ROLLING CONTACT 13326-E
Y.P. CHIU, S K F Industries Incorporated, *Norristown, Pennsylvania* 19406 (DA0Z5579; DAAG29 76 C 0016)

To study the mechanical behavior of machine element contacts, static and moving, in which plastic yielding has occurred. This research is relevant to all vehicles, equipment, helicopters and machines which involve moving parts. An understanding of failure in rolling contacts will lead to better reliability and safety as well as to reduction in wear.

Analytic methods will be used together with computer solutions to find normal and shear stresses in the solid. Plastic flow will be analyzed by an incremental technique and work hardening will be taken into account.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0072, STATISTICAL TECHNIQUES FOR SIGNAL PROCESSING
S.A. KASSAM, Univ. of Pennsylvania, School of Engin. & Appl. Sci., *Philadelphia, Pennsylvania* 19104 (DF046510; AF-AFOSR-3154-77)

AF function - communications and signal processing and instrumentation. Deficiency - there exists a definite need for research in the area of nonparametric and robust statistical techniques which will result in simple and effective tests applicable to practical problems in communication and signal detection and processing. Objective - develop nonparametric and robust testing techniques which can maintain performance at some predetermined level for large classes of probability distribution functions. How work contributes - this research should lead to better design of communication systems and signal processing techniques.

The proposed research will be concerned with various aspects of nonparametric and robust testing methods for signal detection, with major emphasis on nonparametric detection. The research will emphasize the development of detectors based on conditional tests. It is also proposed to study some aspects of nonparametric and robust array detectors. Also investigation of sequential detectors based on the conditional tests will be considered. Recently, some general results on robust tests for the detection of a known signal in contaminated non-Gaussian noise have been obtained by the principal investigator. It is proposed to extend these results to the two-input and multi-input cases for the detection of a common random signal in contaminated noise.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0073, SURVEILLANCE - HIGH-EFFICIENCY LASERS
M.A. BIONDI, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (DN475353; N00014-76-C-0098)

The Navy requires improved high-efficiency lasers for surveillance communications and weaponry. The objective of this work is to investigate new atomic and molecular mechanisms for producing laser action in the visible or near visible spectrum at high efficiency and high power.

Atomic and molecular processes relevant to the development of new laser systems will be studied using a variety of techniques. These include experimental studies of V-V and V-E energy transfer processes of laser interest; electron-ion and ion-ion recombination processes under laser plasma conditions; atomic ion-molecule charge transfer processes; dissociative excitation studies of molecules by electron impact; and, theoretical calculations of energy transfer processes, excimer potential energy curves, and electron impact excitation of both atoms and molecules.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0074, HEAVY-LIFT AIRSHIPS TECHNOLOGY SUPPORT
J.A. ENEY, U.S. Navy, Air Vehicle Technology Dept., *Warminster, Pennsylvania* 18974 (DN581478)

To provide technical support, guidance, and contract monitoring to NAVAIRSYSCOM (AIR-03P3) during the heavy-lift airship research and development program. This includes conceptual design studies, wind tunnel testing, remote-controlled model flight testing, and prototype experimentation.

Two vehicle concepts are under consideration, the 'rotor-balloon' with a rigid rotor affixed to an aerostat centerbody, and the 'quad-rotor' with four articulated rotors flanking and ellipsoidal hull. Both concepts are being carried through model testing and simulation phases. A preferred configuration, when determined, will be prototyped and flight tested.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0075, ADVANCED AERODYNAMIC CONCEPTS
C.J. MAZZA, U.S. Navy, Air Vehicle Technology Dept., *Warminster, Pennsylvania* 18974 (DN481077)

To conduct research in promising areas of advanced aerodynamics, i.e., technologically efficient areas of unique interest to the U.S. Navy.

Through continuing review of the aerodynamics S.O.A. identify areas of significant technological deficiency and establish priorities based upon Navy unique requirements, impact on operational effectiveness, economy of development and solution risk. Seek qualified sources to perform the work, administer study contracts and provide in-depth technical monitoring and overall program management.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0076, CONTROL OF NONLINEAR SYSTEMS
A.E. PEARSON, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DF040420; AF-AFOSR-2793-75)

AF function - design of control system for air-to-air missiles. Deficiency - missile performance in sea has demonstrated that air-to-air missiles have inadequate guidance systems. Objective - the

objective of this research is to develop analytical methods for controlling nonlinear systems. How work contributes - success in developing such methods could enable the implementation of improved guidance schemes for air-to-air missiles.

Research will be conducted in three areas. First, problems in the feedback stabilization of linear time-varying, time invariant, differential and differential-delay systems will be investigated. Second, in the area of nonlinear systems results obtained for the missile intercept problem will be extended to include the bilinear regulator problem. Third, the research in parametric identification and adaptive control will be extended and applied in a variety of ways.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0077, ASSESSMENT AND DEVELOPMENT OF ANALYTICAL MODELS FOR FORCED CONVECTIVE TURBULENT HEAT TRANSFER IN THE NEAR CRITICAL REGION

R.L. REID, Univ. of Tennessee, School of Engineering, *Knoxville, Tennessee* 37916 (NSG 3173)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0078, BALLISTIC SIGNATURE RECORDINGS WITH PHOTOGRAPHIC FILMS

O.M. FRIEDRICH, Univ. of Texas, Applied Research Laboratories, *Austin, Texas* 78712 (NAS 9-15482)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0079, INTERDISCIPLINARY STUDY ON ADVANCED NDI TECHNIQUES

A.B. ELKAREH, Univ. of Houston, School of Engineering, *Houston, Texas* 77004 (DF050150; AF-AFOSR-3457-77)

AF function - nondestructive inspection (NDI) of aircraft and ground support equipment is a vital part of the Air Force mission to detect the effects of loads and flaws. Better inspection techniques, as a product of diligent research, will provide cost-effective management for improved systems and their components. Deficiency - insufficient data exists for the dual problem of residual stress and small defects in layered structures of modern defect-tolerance-oriented design. As a result, more needs to be learned about the temperature dependence of NDI measurements and NDI techniques in general. Objective - this multidisciplinarian approach has an overall objective to develop a better understanding of NDI techniques for different materials used in varied aerospace structures. The proposed research represents an attempt to identify the important models and mechanisms that are controlling in ultrasonics, magnetic flux leakage, eddy current and microwave inspection methodologies. How work contributes - a successful yield for the planned research will contribute through a marked enhancement for better reliability and durability of typical Air Force structures.

Multidisciplinarian research using the skills of training in physics and mathematics, coupled to the capabilities offered by two academic departments (electrical engineering/mechanical engineering), will do analytical and experimental research together in a concentrated assault to better understand the complex variables of NDI. Task A(NAM 77-086), under the direction of Dr. Salama, will pursue ultrasonic challenges while task B (NAM 77-129), directed by Dr. Gardner, is devoted to flux leakage, eddy current and microwave. Both tasks a and b will be managed by the Dean's Office through the capable direction of Dr. A.B. El-Kareh, who offers leadership and structure-properties characterization research. Although the approach is unique (multidisciplinarian with three departments of academe working on one problem) the anticipated yield is promising.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0080, MEASUREMENT OF PERHYDROXYL REACTION RATES

UNKNOWN, Univ. of Cambridge, *Cambridge, England, United Kingdom* (FA77WA-4054; FA160419 (TRAIS NO.))

Using laser magnetic resonance techniques, in a discharge flow system at total pressures near 1 Torr and generating HO2 by the reaction of free atoms with hydrogen peroxide, measure the temperature dependence of the reaction. Using laser magnetic resonance techniques, in a discharge flow system at total pressures near 1 Torr and generating HO2 by the reaction of free atoms with hydrogen peroxide, measure the rate coefficients.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

4.0081, DEVELOP ADVANCED INSTRUMENTATION

UNKNOWN, U.S. Natl. Aero. & Space Adm., Langley Research Center, *Hampton, Virginia* 23665 (FA77WAI-722; FA160246 (TRAIS NO.))

Develop advanced instrumentation (tunable, molecular beam epitaxy-grown, double heterostructure (PbSn) Te laser diodes) to be used in field measurement tests to be conducted over a period of several years. This instrumentation will be a prototype model. This effort is a part of FAA's High Altitude Pollution Program.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

4.0082, PHASE COMPENSATION FOR HIGH-POWER LASERS

W.H. CHRISTIANSEN, Univ. of Washington, School of Engineering, *Seattle, Washington* 98105 (DF048620; AF-AFOSR-3316-77)

AF function - weaponry. Deficiency - high-power laser beam propagation through the atmosphere from an airborne platform typically suffers a loss of effectiveness associated with a rapid wavering of beam direction caused by phase distortion occurring in the laser cavity, optical components, or the atmosphere between laser and target. Correction of this effect is achieved by introducing compensating phase distortions actively controlled in real time by a sensing and control system. Objective - to study the possibilities and limitations of using gas dynamic flows as optical elements for introducing phase compensations in a coherent adaptive optics system. How work contributes - successful outcome of this work could result in more effective laser beam control as well as substantially reduce the flight weight of laser weapon systems.

Arrays of gas jets of different index of refraction will be controlled to achieve given desired phase distortions of plane electromagnetic waves passing laterally through the jets. Means of controlling these jets at the frequencies needed for adaptive optics will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0083, RESEARCH IN RESONANCE IN PARTIAL DIFFERENTIAL EQUATIONS

J. KEVORKIAN, Univ. of Washington, School of Engineering, *Seattle, Washington* 98105 (DF044740; AF-AFOSR-3054-76)

AF function - the modeling of complete flow fields past aerospace vehicles, projectiles and reentry vehicles is of interest to the Air Force. Opportunity - hybrid schemes which use analytical as well as numerical techniques for computing inviscid flows in the near and far field should be exploited. Objective - this research will continue previous work in the areas of nonlinear acoustics, nonlinear wave propagation, and laser plasma interaction. How work contributes - it could provide the computational techniques for investigating flow fields generated by accelerating or maneuvering airfoil in either a uniform or stratified atmosphere.

Techniques developed permit the computation of flow fields due to an accelerating or maneuvering airfoil in either uniform or stratified atmosphere. This research will investigate the effect of typical maneuvers in the overall flow field with particular empha-

sis on the focusing of sonic disturbances in the far field. A hyperbolic domain will be assumed by imposing the boundary condition on the ground at appropriate distance. Second, the modified hodograph transformation will be used to solve the transonic equation. The hodograph solution in a shock-free region with the appropriate jump relations across a shock to determine a transonic flow field containing shocks will be studied. Third, an extension of present work to allow the presence of subsonic region near the ground will be attempted. Another area of research is that of the solution of nonlinear wave propagation problems. The precise conditions required to generate slowly modulated periodic waves will be investigated. Also, the stability of such solutions will be studied. The third area of research is that of laser plasma interaction. Particular attention will be given to the next step in theory by accounting for losses due to diffusion in both radial and axial directions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, AERIAL PHOTO SPECIFICATIONS FOR FORESTRY

R.N. COLWELL, Univ. of California, Agric. Experiment Station, *Berkeley, California* 94720 (0010844; CA-F0-FRU-1329)

OBJECTIVE: Determine, for forested areas, the type of aerial photography from which information essential in the practice of forestry can be most accurately and readily extracted.

APPROACH: The work will be designed so as to permit a determination of the relative ease and accuracy with which forest composition, vigor, density, size, age structure, and land features can be recognized on photography taken with various film-filter combinations, at various scales, and at various times of the day and year. Spectrophotometric analyses of the objects and conditions to be identified will first be made, in order to select the film-filter combinations which theoretically will provide the best photographic tone or color contrasts. Aerial photography of representative forest areas will then be flown with the selected film-filter scale combinations at various times of day and year. Through photo interpretation, estimates will be made from each set of photos as to forest conditions existing within the test areas. The accuracy of the interpretations will be determined by field checking, so that the specifications for optimum forest photography can be formulated.

PROGRESS: Satellite photos taken in the visible red and near infrared bands, respectively, can be used successfully (in conjunction with aerial photos taken with Ektachrome film of sub-sample areas from an altitutde of 5000 feet) to inventory and monitor both the areal extent of snow and the water content of snow in forested areas. Under NASA sponsorship we are preparing 'Procedural Manuals' for use by those who wish to use such techniques either in California's Sierra Nevada Mountains, where we have conducted our research, or elsewhere. We also have conducted tests on the interpretability of vegetation resources in California and Australia in various image types acquired from earth orbiting spacecraft.

SUPPORTED BY California State Government

5.0002, STUDIES OF RADIATIVE TRANSFER IN PLANETARY ATMOSPHERES

J.N. CUZZI, Univ. of California, Graduate School, *Berkeley, California* 94720 (NCA 2-50802)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0003, SOME ASPECTS OF THE PHOTOCHEMISTRY OF THE ATMOSPHERES OF MARS AND EARTH

Y.L. YUNG, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (NSG 2283)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0004, STUDY TO EXAMINE THE PROPERTIES AND DISTRIBUTION OF METEOR ABLATION DEBRIS IN DEEP SEA SEDIMENTS

M.E. MADDOCK, Calif. State Univ. & Colleges, School of Science, *San Jose, California* 95114 (NSG 2278)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0005, A FEASIBILITY STUDY FOR COTTON IDENTIFICATION FROM LANDSAT IMAGERY FOR THE CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE PINK BOLLWORM PROJECT

J.E. ESTES, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (NCA 2-680801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0006, WIND TUNNEL SIMULATIONS OF MARTIAN SAND STORMS

R. GREELEY, Univ. of Santa Clara, School of Science, *Santa Clara, California* 95053 (NSG 2286)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0007, THEORETICAL OPTICAL SENSING

S. CLIFFORD, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8AA70A11)

PROJECT OBJECTIVE: Theoretical studies and computer simulations of the use of optical and infrared beams for remotely sensing atmospheric parameters, particularly wind, turbulence, and precipitation.

CURRENT YEAR PLAN: Continue theoretical analysis of various infrared and optical methods of sensing atmospheric parameters, particularly heat and moisture fluxes.

PROGRESS REPORT: Developed the theory of using path-averaged measurements of structure parameters to infer momentum, heat, and moisture fluxes.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Labs.

5.0008, TROPICAL CYCLONES AS REVEALED BY COMPOSITED RADIOSONDE DATA

W.M. GRAY, Colorado State University, School of Engineering, *Fort Collins, Colorado* 80523 (ATM76-23539)

This investigation proposes to examine the three-dimensional structure and dynamics of hurricanes and typhoons from composited radiosonde data. The data are taken from both Atlantic and Pacific Oceans and comprise the effective period of record. The results will permit an examination of the budgets of (1) mass, (2) momentum, (3) kinetic energy, and (4) static energy. It is expected that sufficient data will be available to examine these various budgets as a function of storm age, central pressure, geographical location, time of day, etc. Much additional insight into the structure and dynamical characteristics of tropical cyclones should be forthcoming.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0009, GEOCHEMICAL DATA SYNTHESIS AND ANALYSIS

J.A. PHILPOTTS, Univ. of Hawaii, Graduate School, *Honolulu, Hawaii* 96822 (NSG 5203)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0010, INVERSE PROBLEMS IN SCATTERING AND GEOPHYSICS
V. BARCILON, Univ. of Chicago, School of Humanities, *Chicago, Illinois* 60637 (DN575174; N00014-76-C-0034)

Inverse problems arise in problems in which information is desired about a scattering obstacle, a source distribution or an inhomogeneity of a medium from remotely sensed data. Naval applications include reconstruction of a scattering obstacle (ship, aircraft, missile), with sufficient accuracy for classification and identification purposes, reconstruction of soundspeed profiles in the ocean, design of antennas from the desired farfield pattern and identification of location and size and shape of objects buried in the earth or submerged in the water. The objective of this task is to develop mathematical methods for treating inverse problems.

Numerical and analytic techniques will be developed to treat inverse eigenvalue problems. Applications considered will be primarily from geophysics and inverse scattering.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0011, TRANSIONOSPHERIC PROPAGATION - MIDDLE EAST
H.K. AFSHAR, Geophysics Institute, *Tehran, Iran* (DF268990; AF-AFOSR-2673-74)

AF function - communications, radar and navigation. Deficiency or opportunity - lack of knowledge of the low-latitude ionosphere yields communications outages and navigation inaccuracies. Objective - the object of this research is to measure and catalogue ionospheric parameters over the Middle East. How research contributes - measuring scintillation and electron content provides input data to a global ionospheric model used for navigation error and signal loss prediction.

The approach is to observe total electron content in the Middle East by polarimetry of signals from transmitting satellites.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0012, RADAR MEASUREMENTS IN AGRICULTURAL APPLICATIONS
F.T. ULABY, Univ. of Kansas, School of Engineering, *Lawrence, Kansas* 66044 (NAS 9-15421)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0013, STORM DIAGNOSIS
R.J. DONALDSON, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF254550)

Air Force function - protection of aerospace systems in severe storms. Deficiency - identification and warning of storm hazards by current methods are unreliable. Objective - develop radar techniques for diagnosis of storms and attendant precipitation and wind fields. How development contributes - provides improved identification and prediction of convective storm hazards and more reliable definition of scattering and attenuation of microwaves in adverse weather.

Measurements of shear anomalies and reflectivity structure provide data for identification of severe convective storms and for study of storm organization and trend as revealed by interaction of fields of motion and precipitation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0014, FREE BALLOON SHAPE AND STRESS ANALYSIS
J.F. DWYER, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF240240)

AF function - advanced balloon systems (surveillance, delivery operations, environmental research support, space equipment test). Deficiency - adequate design and analysis procedures for free balloons do not exist. Objective - develop a generalized computer code for the analysis and implementation of advanced free balloon design concepts. How research contributes - developed procedures will permit accurate definition of payload capability and improvement of reliability and efficiency.

Balloon design and analysis problems are generally based on determination of the balloon shape and/or stress distribution. A general computer program is being written as part of tandem balloon and constant volume balloon studies and will be accomplished in a manner suitable to the solution of such shape/stress determinations so as to provide a tool for analyzing criteria developed under contract to thereby improve capability, reliability and efficiency of free balloons.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0015, SATELLITE EPHEMERIS COMPUTATIONS
D.F. GILLETTE, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF247320)

AF function - satellite tracking and surveillance, ballistic nuclear weapon delivery. Deficiency - deficiencies exist in current vehicle ephemeris calculation programs in the areas of atmospheric and geopotential models. Research - comparison and testing of advanced atmospheric and geopotential models for possible use in the Cheyenne Mountain update program. How research contributes - improves ability to determine and predict satellite position as a function of time with smaller computer requirements.

Computer programs involving numerical interpretation of the canonical equations of motion of an earth satellite and employing various density and geopotential models are used to predict satellite ephemerides. Test comparisons with operational density and geopotential models will be made to determine the need for making changes in operational systems. Specific emphasis is placed on computer execution time and storage. A wide range of satellites will be studied under various solar/geomagnetic conditions so as to determine the best combinations of geopotential-atmospheric models for Air Force needs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0016, GEODETIC LASER RANGING
R.W. KING, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249310)

AF function - strategic weapons delivery. Objective - to investigate the use of precise extraterrestrial measurement techniques (lunar and satellite laser ranging and very-long-baseline interferometry) to determine basic geodetic parameters. How research contributes - intercontinental geodetic ties, earth rotation and polar motion must be determined with improved resolution and reliability to attain projected ICBM accuracies over the next decade. These parameters affect the G&G (geodesy and geophysics) and G&C (guidance and control) CEP's (circular errors probable) of Minuteman III and M-X.

Data from laser ranging observations of the moon and the laser geodetic satellite (LAGEOS), and data from very-long-baseline interferometric (VLBI) observations of extragalactic radio sources will be analyzed to determine earth rotation, polar motion, and solid-earth tides.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0017, DISSOCIATION OF NITROGEN OXIDE IONS AND METALLIC OXIDES
J.F. PAULSON, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249160)

AF function - environmental effects of AF operations, nuclear weapons effects. Deficiency - the environmental and geophysical effects of AF operations in the atmosphere cannot be accurately predicted. Objective - to measure cross sections for

photodissociation of atmospheric positive ions, especially nitrous oxide and nitrogen dioxide, and to measure thermochemical properties of metal oxides. How research contributes - provides information required in computer models used to predict environmental and geophysical effects of AF operations in the stratosphere and ionosphere.

Photodissociation cross sections are measured using a double mass spectrometer to which is coupled a tunable dye laser with frequency doubler. Ionic products of the photodissociation reactions are mass and velocity analyzed. Thermochemical properties of gaseous metal oxides are measured in a mass spectrometer equipped with a Knudsen cell, allowing production of the desired molecules at a known temperature in the vapor phase. Measurements are made of ionization and appearance potentials and bond dissociation energies.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0018, CLIMATIC CHAMBER TEST OF AN ICE ACCRETION MEASURING SYSTEM

P.I. TATTELMAN, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249470)

AF function - engineering design. Deficiency - current icing information is inadequate to develop reliable engineering design criteria. Objective - determine the feasibility of taking objective observations of ice accretion. How development contributes - provide input to AF design of systems for which ice accretion at the earth's surface is critical.

The Rosemount Engineering Co., Minneapolis, MN builds and markets ice detectors to detect ice formation in aircraft engines. Four detectors and a controller to operate them will be purchased from Rosemount. These will be linked with a recorder for our meteorological purposes. These detectors will then be tested in various orientations to determine the optimum arrangement of the sensors for measuring ice accretion. The testing will be accomplished in the 'all-weather room' of the Armament Development and Test Center at Eglin AFB. The detectors will be tested for a wide range of meteorological conditions to relate instrument ice detection to ice accretion on several sizes of metal rods and flat plates in varying orientations. This effort will require attendance of the work unit scientist during five weeks of testing at Eglin AFB. Data collected at the test facility will be summarized in report form to provide input on the manner in which ice is deposited on structural members of exposed systems. If it is determined that accurate measurements of ice accretion can be made using the Rosemount system, it will be referred to AWS for use as a network instrument for the collection of ice accretion data. This would fulfill AWS technical need 2-76. The final report will include recommendations on use and deployment. Data collection will be done by the AWS after termination of the work unit. Data collected will be used by AFGL at some future time to develop climatologies of ice accretion for design.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0019, AURORAL IONOSPHERIC STATES INFERRED FROM E-REGION PARAMETERS

J.A. WHALEN, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF244690)

AF function - communication, radar, navigation, and surveillance. Deficiency - the polar ionosphere is presently very unpredictable to such a degree that the above functions are frequently degraded or crippled. Research - to define the high-latitude ionospheric environment and its impact on AF systems. How research contributes - the high-latitude ionospheric environment affects AF ground, airborne and satellite communications, radar, navigation and surveillance systems. The specific objective is more accurate specification of ionospheric parameters for OTH radar SPO's, communication satellite SPO's survivable communications, DSP, DMSP, GPS and AWS and their customers. The long-range contribution will be to assist the complete theoretical understanding of the complex magnetospheric interactions ultimately necessary for reliable operation of the above functions.

An airborne expedition to measure equatorial scintillations will be undertaken in Mar 77. A study of auroral structure and activity in the high-latitude auroral oval will be completed in May 77. A preliminary report on the all-sky photometer will be completed in June 77. In Sept 77 a study on the continuous aurora and auroral states will be completed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0020, LOW-ENERGY PLASMA MOTION

P.J. WILDMAN, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF248940)

AF function - FY77 - communication, surveillance, navigation and ionospheric modeling. Deficiency - inadequate knowledge of bulk motion of ionospheric and magnetospheric plasma inhibits prediction of ionospheric irregularities and density gradients. Objective - use plasma bulk measurements to improve modeling of ionospheric dynamics at all latitudes. Develop improved instrumentation. How research contributes -permits prediction of mid-latitude trough and plasma morphology at high latitudes.

Data for PHR experiments on S3 series satellites will be analyzed to determine plasma bulk motions, and their variation with geophysical parameters. Criteria for improving instrumentation will be developed during the examination of the experiment data.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0021, PROBE TELEMETRY SYSTEMS

R.E. WILTON, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF243970)

AF function - research probe telemetry. Deficiency or opportunity -a standardized telemetry and transponder section is required for use with rocket instrumentation systems. Additionally, an effective technique for utilizing PCM telemetry data at remote site locations is required. Objective - develop improved and standardized telemetry systems for use with AFGL research rocket payloads. Systems to include integrated telemetry and transponder beacons where required. To also develop techniques and equipment to provide for computer-controlled PCM telemetry checkout of complex rocket payloads. How research contributes - systems to be developed will provide standardization for many future programs which will result in increased capabilities, improved reliability, and reduction of engineering time for providing effective telemetry and transponder systems. Rapid use of PCM telemetry data, at remote sites, in real time, will also be possible by use of the computer-controlled PCM check-out system to be developed.

The technical approach will include new and economical construction techniques that utilize highly reliable, commercial telemetry components and transponder systems. The unique aspect of this development will be an integrated, flush-mounted antenna system which will allow for combining the s-band telemetry with either an s-band or a c-band transponder antenna system into one strip line section. Included in this standard telemetry system will be an improved in-flight calibration unit that will incorporate the most favorable features of the several types of calibration systems previously used. A series of separate component developments and tests will be utilized to provide the final specifications of the telemetry and transponder system that will be considered as standard for used on UTE/Paiute-Tomahawk rocket payloads. Concurrently, with the telemetry system effort, a computer-controlled PCM check-out system will be developed. This will utilize an existing mini-computer and it will provide a rapid, real time readout capability in engineering units from PCM telemetry systems, both in the laboratory and at remote field sites.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0022, SATELLITE INSTRUMENTATION FOR HIGH-ENERGY PARTICLES

K.G. YATES, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF580070)

AF function - navigation, communication and surveillance. Deficiency u inaccurate environmental specification for hardness of microelectronic components will result in insufficient criteria for military satellite systems. Objective - to design, test and calibrate high-energy particle and magnetic flux detectors for satellite observations. How research contributes - direct measurement of the energetic particle environment in space will lead to a useful model resolving uncertainties in calculations of radiation hardening requirements.

Designs of state-of-the-art instruments for measuring high-energy particles and magnetic flux will be completed. Fabricated instruments acquired under contractual work units supporting this task will be tested and calibrated in preparation for satellite integration.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0023, NAVY ENVIRONMENT - SPACECRAFT OCEANOGRAPHIC REMOTE SENSING

E.L. MOLLOCHRISTENSE, Mass. Inst. of Technology, School of Science, *Cambridge*, *Massachusetts* 02139 (DN675201; N00014-75-C-0291)

An improved knowledge of the capabilities of spacecraft for remote sensing of the oceans is required if we are to fully utilize these systems for surveillance, as well as non-acoustic and acoustic ASW purposes. The objective of this task is to assess how well passive spacecraft remote sensing techniques can be used to map oceanic features such as fronts, surface expressions of internal tides, and current systems.

The contractor will work, for example, with the Spacecraft Science and Engineering Center at the U. of Wisconsin to look over the extent of archived data; he will work with our contractors at Scripps and the U. of Miami in defining what ground truth experiments will be needed to identify the features noted in the archived data; and he then will suggest how remote sensing techniques might best be used for oceanographic monitoring purposes.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0024, TROPICAL CYCLONE FORECASTING

F. SANDERS, Mass. Inst. of Technology, School of Science, *Cambridge*, *Massachusetts* 02139 (DF243350; F19628-75-C-0059)

AF function - typhoon analysis and prediction. Deficiency or opportunity - inadequate data to make reliable typhoon forecasts. Objective - evaluate the use of satellite deduced winds in prediction models. How development contributes - established whether routine satellite observations can improve tropical storm forecasting.

The Sanbar model shows promise of being a very useful tool for forecasting tropical storm motion. It relies on information derived from wind soundings. Much of this information must be estimated because of an insufficient data network over the oceans. The motion of clouds from frame in geosynchronous satellite pictures can be used to infer winds at the cloud levels. The MCIDAS system at AFCRL will be used to generate such winds. The contractor will first determine if the cloud motions at several levels in the atmosphere can be used to simulate the observed mean wind in the troposphere and, if so, the degree of improvement in the forecasts resulting from the substitution of satellite-deduced winds in the Sanbar forecast model. The one problem that may develop is getting storm data in the proper format during the short term of the contract.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0025, INTERFEROGRAM DATA ACQUISITION SYSTEM FOR BALLOON-BORNE CRYOGENIC INTERFEROMETER

J.L. PRITCHARD, Idealab Incorporated, *Franklin*, *Massachusetts* 02038 (DF248480; F19628-77-C-0039)

AF function - surveillance, advanced infrared detection system. Deficiency - lack of high-resolution data of stratospheric emittance in infrared. Objective - to acquire and handle interferogram signal from cryogenically operated interferometer in balloon-borne environment. How research contributes - an instrument sensitive enough to measure stratospheric emission will be made ready for a balloon-borne operation.

A system for acquiring and handling an interferogram signal from a cryogenically operated high-resolution IR interferometer will be designed and fabricated. Tests for interfacing will be conducted to see whether the full sensitivity of the instrument will be achieved to insure a detection of the stratospheric emission for a proposed balloon-borne experiment.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0026, DIAGNOSIS OF GREEN VEGETATION BY REMOTE SPECTRAL MEASUREMENT

J. SOUSA, U.S. Army, Natick Research & Dev. Command, *Natick*, *Massachusetts* 01760 (DA0G4363)

The in vivo spectral characteristics (i.e., reflectance, absorbance, emission) of higher plants will be measured as a function of the life cycle of the plant. The physical state of the plant, in particular, the life stage and plant condition, and these spectral properties will be evaluated to determine correlations between the spectral variations, the photosynthetic pigments, and the plant condition.

Rapid and accurate measurement of the spectral characteristics of higher plants can be made from the UV into the IR region of the spectrum, using a modified rapid-scan spectrometer for field and laboratory measurements of reflectance, absorbance and emission.

SUPPORTED BY U.S. Dept. of Defense, Army, Natick Research & Development Command

5.0027, IMAGING ALL-SKY PHOTOMETER

R.H. EATHER, Keo Consultants, *Newton*, *Massachusetts* (DF249780; F19628-76-C-0168)

AF function - communications and detection. Deficiency - understanding effects both of precipitating particle and non-particle produced ionospheric disturbances which degrade communications at high and equatorial magnetic latitudes. Objective - investigate ionospheric disturbance phenomena by means of auroral spectral emission features measured with a sensitive T.V. system. How research contributes -provides a new and powerful technique for large-scale and high time resolution auroral measurements. Coordination with other simultaneous measurements from the AFCRL Airborne Ionospheric Observatory, NKC-135 aircraft, number 53131, will allow comprehensive measurements of ionospheric response to substorms over subauroral, auroral and polar cap domains.

Design, develop and construct an ultra-high-sensitivity, low-light-level T.V. system capable of wavelength discrimination, all-sky viewing and signal processing to accurately measure auroral emissions in the visible region of the spectrum.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0028, ELECTRON DENSITY PROFILES APPLIED TO SATELLITE DETECTION/NAVIGATION

L. BURKE, Regis College, Undergraduate School, *Weston*, *Massachusetts* 02193 (DF247920; F19628-76-C-0255)

AF function - advanced radar and satellite navigation systems. Deficiency - the ionosphere introduces range and angle errors in the SPADATS tracking radars and in planned navigation systems. Objective -develop and validate models, computer algorithms and on-site specification procedures to provide real time specification of range and angle tracking errors and to provide post-event calibration of tracking and navigation systems using actual data obtained at ground-based ionospheric stations, obtained from in-situ satellite measurements and obtained from SPADATS radars. How research contributes - improves radar tracking and satellite navigation systems by developing algorithms

and procedures to use on-site measurements to update models of expected mean range and angle error.

Investigate range and angle errors of tracking radar and navigation systems. Develop relationships to use on-site measurements of ionospheric parameters. Develop and validate computer algorithms for real-time and post-event corrections.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0029, CLIMATOLOGICAL AND STATISTICAL DATA ANALYSIS

L. BURKE, Regis College, Undergraduate School, *Weston, Massachusetts* 02193 (DF279870; F19628-76-C-0009)

AF function - design of aerospace systems. Deficiency - require meteorological data in greater detail and complexity for adequate design and aerospace operational doctrine. Research - methods of synthesizing and presenting available information. How research contributes -describes the variability of atmospheric parameters in formats required in Air Force design and operation. Objective - the objective of this program is to perform mathematical and statistical operations on all types of meteorological observational data. This includes analysis and evaluation of meteorological records, rocket and balloon flight data, aircraft and field test data.

Apply statistical and meteorological theory along with computer techniques to the climatic record.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0030, THEORETICAL INVESTIGATION TO IDENTIFY AND DEVELOP SPECIFIC AERONOMIC STUDIES AND PROBLEMS ADAPTABLE TO THE AE SATELLITE

J. WALKER, Univ. of Michigan, Graduate School, *Ann Arbor, Michigan* 48104 (NAS 5-24331)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0031, DEVELOPMENT OF AUTOMATED PROCEDURES FOR CHANGE DETECTION AND LAND USE MAPPING FROM SATELLITE DATA

H. STRUVE, U.S. Army, Waterways Experiment Station, *Vicksburg, Mississippi* 39180 (DA0W8184)

To develop and demonstrate automated procedures for obtaining land use classifications from satellite data that are acceptable for use by the Corps divisions and districts in detecting land use changes and producing land use maps.

Computer procedures will be developed that will automatically and/or interactively (1) locate and extract spectral data from satellite magnetic data tapes for specified geographic regions and sort the data into unique signatures on the basis of radiance values recorded for each pixel for four spectral bands, (2) remove instrument noise and correct radiance values for the effects of terrain slopes, shadows, and atmospheric conditions, (3) rectify positions of satellite pixel elements to the UTM coordinate system of topographic base maps, (4) classify the sorted radiance values on the basis of spectral signatures for land use types verified at specific locations, and (5) compare radiance values from two satellite flyovers and portray changes in land use on a map overlay. The accuracy of land use mapping procedures will be demonstrated for selected areas in four Corps of Engineers districts, namely, New Orleans, Mobile, Huntington, and Omaha.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Waterways Experiment Station

5.0032, GROUND CONDUCTIVITY WAVE TILT MEASUREMENTS

UNKNOWN, U.S. Army, Cold Reg. Res. & Engin. Lab., *Hanover, New Hampshire* 03755 (FATQWAI-707; FA59855 (TRAIS NO.))

Develop airborne and ground conductivity measurement methods for use in spectrum engineering, site selection, and resistivity mapping. A conductivity map based on geological data and limited measurements is to be generated for frequency assignment purposes.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

5.0033, GRAVITY AND ACOUSTIC WAVES APPLIED TO THE DYNAMICS AND KINEMATICS OF THE ATMOSPHERE 14846-GS

W.L. DONN, Columbia University, Lamont Doherty Geolog. Observ., *Palisades, New York* 10964 (DA0F9005; DAAG29 77 G0131)

To develop the application of infrasound as a possible probe for the remote sensing of wind-temperature parameters of the stratosphere and lower thermosphere--and the relation of gravity waves in the atmosphere to meteorological conditions. Relevance - the research attacks several Army meteorological problems, including the role of internal gravity waves in determining the structure of the upper atmosphere and the response of the upper atmosphere to nuclear disturbances, the relation between gravity waves and precipitation and severe storm development, remote sensing of wind-temperature parameters of the upper atmosphere, and detection of ballistic missiles in flight for early warning.

Use observations from the present ground array of capacitor-type microphone sensors at Lamont Observatory and a companion array to be established at the meteor radar laboratory of the U. of New Hampshire to compare estimates of wind conditions at reflecting levels aloft to those determined by radar echoes from meteor trails and study the effect of gravity waves on precipitation and severe storms.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

5.0034, PHOTODISSOCIATION OF ATMOSPHERIC POSITIVE IONS

R.C. DUNBAR, Case Western Reserve Univ., Graduate School, *Cleveland, Ohio* 44106 (DF249020; F19628-77-C-0157)

AF function - environmental effects of AF operations, nuclear weapons effects, nuclear weapons delivery. Deficiency - the environmental and geophysical effects of AF operations in the atmosphere cannot be accurately predicted. Objective - to measure cross sections for photodissociation and collisional deactivation of atmospheric positive ions using two-photon absorption techniques. How research contributes - provides information required in computer models used to predict environmental and geophysical effects of AF operations in the stratosphere and ionosphere.

Photodissociation cross sections, spectra, and products are measured using an ion cyclotron resonance mass spectrometer to which is coupled a continuous wave tunable dye laser. Collisional deactivation of vibrationally excited ions is studied by varying the mean time between collisions for ions excited by absorption of one photon and subject to dissociation by absorption of a second photon.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LKB, Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense, Air Force

5.0035, DOCUMENTATION OF THE TANSY RAGWORT REMOTE SENSING PROJECT

R.D. CRENSHAW, Oregon State Higher Educ. Sys., Graduate School, *Corvallis, Oregon* 97331 (NCA 2-586802)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0036, SOIL MOISTURE WORKSHOP

V.I. MYERS, South Dakota State University, School of Engineering, *Brookings, South Dakota* 57006 (NAS 5-24358)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0037, COMPUTER MODEL OF PLASMA FLOW NEAR THE EARTH'S PLASMAPAUSE
R.A. WOLF, Rice University, Graduate School, *Houston, Texas* 77001 (DF248280; F19628-77-C-0012)

AF function - communications, navigation, ionosphere and magnetosphere modelling. Deficiency - inadequate knowledge of how convective processes in magnetosphere perturb ionospheric structure characteristics which in turn affect AF communication systems design. Objective - develop computer models for time-dependent convective flow. Analyze and synthesize AF satellite data. How research contributes -provides data essential to radar propagation, provides data essential for design and utilization of communication, guidance and surveillance systems, provides understanding of dynamical ionospheric/magnetospheric processes.

Construct computer models for time-dependent convection in the ionosphere and magnetosphere at auroral and middle latitudes using electric fields and plasmas observed by AF satellites at realistic boundary conditions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0038, METHOD OF INFERRING MESOSCALE MIXING PHENOMENON
L.R. MEGILL, Utah Higher Education System, Graduate School, *Logan, Utah* 84321 (NSG 7388)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0039, IMPROVED HYDROLOGIC SURVEY CAPABILITIES
W.R. COOK, U.S. Army, Geographic Applications Div., *Fort Belvoir, Virginia* 22060 (DA0M8111)

To determine feasibility of developing optical sensors that will provide specific stream measurements such as water velocity, and stream width from remote positions such as in aircraft, armored or other vehicles and forward observation sites.

Utilizing reports and specifications resulting from previous USGS work in this area, conduct a design study for a state-of-the-art model. Based on results of study, build a brassboard model for use in conducting experiments to determine feasibility of technical objectives. Related ongoing efforts by other DoD agencies, industry, civil government agencies and allied nations will also be investigated to determine potential application to this effort. This will be a joint USAETL-USGS project. For those technical objectives that appear feasible, based on the results of these investigations, work will continue under project 4A763712D862 (Artins) commencing in FY 78.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Engineer Topographic Lab.

5.0040, REMOTE SENSING RESEARCH IN SUPPORT OF AIR CUSHION VEHICLE EMPLOYMENT
J.P. HENLEY, U.S. Army, Remote Sensing Center, *Fort Belvoir, Virginia* 22060 (DA0N8007)

A) To evaluate remote sensing imagery as a means for rapidly and economically obtaining terrain information pertinent to ACV operations, and b) to acquire knowledge about probable ACV movement capabilities in Europe which will assist in developing ACV employment doctrine for the area.

Contacts will be made with TRADOC and other agencies to determine operational characteristics and limiting terrain factors associated with the planned employment of ACV's. Once critical terrain elements have been identified, research will concentrate on deriving movement capability overlays (slope classes, vegetation, land use, shoaling, obstacles, etc.) from all available imagery forms of representative test areas of Europe. In addition to providing direct support to ACV operations, these overlays and maneuver capability patterns would permit TRADOC to develop realistic tactical employment doctrine for ACV's in conjunction with the vehicle development program. Maneuvering limitations identified within the terrain units (via remote sensor imagery) could also serve as a basis for realistic and practical design modification early in the development cycle. Methodology will be prepared in two forms: 1) a descriptive, easily understood pamphlet with accompanying overlays, and 2) a more detailed technical report outlining preparation procedures, skill levels and planning details to enable military units within the operational area, such as terrain detachments, to produce similar studies on a routine basis.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Engineer Topographic Lab.

5.0041, INVESTIGATION OF POTENTIAL OF DIFFERENTIAL ABSORPTION LIDAR TECHNIQUES FOR REMOTE SENSING OF ATMOSPHERIC POLLUTANTS
E.C. KINDLE, Old Dominion University, School of Sciences & Health, *Norfolk, Virginia* 23508 (NSG 1477)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0042, THE MEASUREMENT AND METEOROLOGICAL SIGNIFICANCE OF SAHARAN DUST AS OBSERVED BY GEOSYNCHRONOUS SATELLITES
D.W. MARTIN, Univ. of Wisconsin, Space Science & Engr. Center, *Madison, Wisconsin* 53706 (ATM77-11691)

The objectives of this research are to: (1) develop a model to obtain satellite-derived estimates of atmospheric turbidity over the oceans. This will be accomplished using the GARP Atlantic Tropical Experiment (GATE) observations, as well as current observations, of atmospheric turbidity; (2) archive a satellite data base for significant aerosol outbreaks identified by current ground based observations of atmospheric turbidity; and (3) better understand the large-scale circulations during dust outbreaks.

In developing a technique to measure turbidity, a basic property of the atmosphere, and in providing a synoptic description of that property, this research supports the objectives of the First GARP Global Experiment (FGGE).

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, SIMULATOR DESIGN CONFIGURATIONS STUDY 2 - MOTION G-SEAT-VISUAL EFFECTS AND INTERACTIONS
G.H. BUCKLAND, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF222920)

To assess the performance of experienced pilots (i.e., T-37 instructor pilots) under various ASUPT motion, g-seat, field-of-view (FOV), and ceiling/visibility (C/V) configurations. The study will provide a partial replication and an extension of study I (MVG-I) which discovered prominent main and interactive effects when such conditions were used as independent variables.

Study I was designed as a screening study. As such, it explored a large multidimensional experimental space using a minimal number of subjects. Study II is designed to partially replicate and extend the major findings of study I using a more traditional and conservative approach (e.g., full factorial design, and more subjects). Five experienced T-37 instructor pilots will fly five maneuvers under 27 ASUPT configurations in which motion, field-of-view, and g-seat are varied. The results from this study should aid greatly in the interpretation of MVG-I and begin to clarify certain aspects of motion-visual issues in simulation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0002, DEVELOPMENT AND EVALUATION OF PERFORMANCE MEASURES FOR TAC COMBAT CREW TRAINING

L.D. POHLMANN, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF222000)

The development of a performance measurement system to be used in evaluation of the training effectiveness for TAC ground-based simulator training systems. Primary areas of concern will be the development of objective measurements for: (1) takeoffs and landings, (2) air-to-ground weapons delivery, (3) air-to-air combat maneuvering, (4) instrument, and (5) navigation maneuvers. It is anticipated that the resulting measurement system would be an adjunct to the present training program as well as a tool for use in planned research evaluations of these training devices. A further objective is the development of an empirical data base reflecting performance standards of both experienced F-4 instructor pilots and students as they progress through F-4 training programs.

A criterion-referenced approach to pilot performance measurement has been utilized in measurement system development for ASUPT and shown to be highly effective. The development of the measurement system for each training area will require four phases: (1) definition of the criterion objectives for each task in terms of a potential set of simulator parameters, (2) evaluation of the proposed set of measures for the purpose of validation and simplification, (3) definition of criterion performance by requiring experienced combat crews to fly the task in question, and (4) collection of normative data using students as they progress through the simulator training program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0003, F-15 TRAINING SYSTEM EVALUATION (OT&E)

J.C. REED, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF223370)

To support the operational test and evaluation (OT&E) of the F-15A flight simulator evaluating the operational effectiveness of system performance in student and continuation training and by evaluating system performance when operated and maintained by military personnel in the field.

(1) Instructors and students will subjectively assess the training effectiveness of the simulator. (2) A transfer of training study will be part of the late phases of the project. (3) Scoring algorithms will be validated by comparing instructor and simulator generated ratings of performance. (4) Questionnaires and interviews will be used to evaluate the utility and effectiveness of the instructional features of the system and the console. (5) An assessment of engineering fidelity will be made by comparing simulator response to available aircraft data and pilot judgements. (6) Maintenance and reliability will be closely monitored. (7) Cost data and estimates will be collected and analyzed for incorporation into life-cycle cost models. AFHRL/FT will provide consultative support in experimental design, methodology development, data collection monitoring, data analysis, and interpretation and reporting of the project results.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0004, HEAD/NECK INJURY MECHANISMS AND INJURY KINETICS

R.W. CARR, Ultrasystems Incorporated, *Phoenix, Arizona* 85027 (DN123395; N00014-71-C-0318)

A primary objective of this research is to determine head/neck injury mechanisms and injury kinetics associated with Navy aircraft accidents. The goal of the research is to provide naval crash injury researchers with a ready reference containing new, and already available, information on injury mechanisms, injury kinetics, human tolerances, human inertial properties, human dimensional properties and injury indices.

An analysis of naval aircraft accidents is being made to determine the distribution of types of head injuries. Of immediate interest to researchers investigating head injury is the mechanism by which it occurs in naval aircraft accidents. The investigation will examine if head injury is more frequently caused by direct or indirect impact of the head.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

6.0005, ROLE OF GRAVITY IN PREPARATIVE ELECTROPHORESIS

M. BIER, U.S. Veterans Administration, Hospital, *Tucson, Arizona* 85713 (134-22-4233; 678-004-P)

This program on the development of a zero-gravity electrophoresis facility for the Shuttle System, presently under construction by NASA, has been most exceptionally productive, as evident from the total of 14 publications which have resulted, so far, from the work of the P.I. and his associates at the University of Arizona. In addition, the P.I. had space experiments on isotachophoresis of human and rabbit erythrocytes aboard the Skylab III and the recent joint Apollo-Soyuz Missions. Two new prototypes of electrophoretic instruments were developed for cell separations, one of which was described in the literature (1), and for the other patent disclosures were filed with the VACO and NASA.

As originally foreseen, the program has shifted from an initially theoretical direction, towards an essentially experimental investigation of techniques suitable for zero-gravity electrophoresis. As a result, above collaborators are no longer associated with the program. Dr. Ann Kopwillem, an expert on isotachophoresis, has participated in the program for a period of 15 months, and is on leave of absence from her position with LKB in Stockholm.

SUPPORTED BY U.S. Veterans Admin., Dept. of Medicine & Surgery

6.0006, NEUROPHYSIOLOGICAL RESEARCH IN ADAPTIVE NETWORK ARCHITECTURES

C.D. WOODY, Univ. of California, School of Medicine, *Los Angeles, California* 90024 (DF043620; AF-AFOSR-3074-76)

AF function - the Air Force needs new methodologies for the design of improved adaptive networks which are applicable to artificial intelligence operations such as automated image recognition, speech coding and decoding, robotics, and computer-aided decision-making. Deficiency - both brain and machine depend on component operations. There is reason to believe that systems supporting complex, goal-seeking adaptive behavior are best constructed from goal-seeking adaptive components. Limited understanding of how such components work has prevented their incorporation into artificial intelligence systems. Objective - the general objective is to improve the ability to design adaptive network architectures by investigating neuronal adaptive mechanisms underlying intelligent information processing in the brain. How work contributes - this research should lead to an improved understanding of the control of adaptive mechanisms underlying information processing by the brain and afford the design of improved components for use in artificial intelligence. This research is in direct support of efforts at System Avionics Division, AF Avionics Laboratory.

The brain is the most powerful adaptive network known and the basic component of the brain is the neuron. Recent studies indicate that single cortical neurons adapt in relation to adaptive mammalian behavior. By investigating these adaptive neural elements it is hoped to determine if cellular mechanisms controlling this adaptation operate in a goal-seeking manner, which might involve maximization of excitatory or inhibitory conductances, cyclic nucleotide gradients or other measureable variables that influence the level of neural excitability. The approach is to study control of changes in cellular excitability directly in single cortical neurons. The heterostatic theory of adaptive systems proposes that the individual elemental component is itself a goal-seeking system and that the goal sought is a maximal rather than a steady-state condition. This hypothesis deserves consideration and the research proposed appears to so do and is a logical approach to the general problem.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0007, PREBIOTIC COMPLEMENTARY PAIRING OF AMINO ACIDS, SCHIFF BASES AND REVERSE TRANSLATION FOR ORIGIN OF GENETIC CODE (ABBREV)
B.L. STREHLER, Univ. of Southern California, School of Letters Arts & Sci., *Los Angeles, California* 90007 (NSG 7367)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0008, ASSESSMENT OF MOTION SICKNESS IN RATS - AN INVESTIGATION OF PICA AS THE RELEVANT BEHAVIORAL MANIFESTATION
R. FOX, Calif. State Univ. & Colleges, School of Social Science, *San Jose, California* 95114 (NCA 2-675801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0009, INSTRUCTOR PILOT'S ROLE IN SIMULATOR TRAINING
J.P. CHARLES, Appli Mation Incorporated, *Orlando, Florida* 32803 (DN594008; N61339-75-C-0093)

The objective of this task is to define the role of the instructor pilot (and simulator operator, if needed) in all phases of flight training in which an operational flight trainer is an integral tool; and to specify functional designs for a console at which the defined role may be carried out.

The approach will consist of the following steps: (1) review state-of-the-art and survey present and predictable future programs for training instructor pilots; (2) systematically determine requirements for instructor pilot consoles; (3) develop functional designs for consoles based on these requirements.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Training Equipment Center

6.0010, PREDICTING MOTIVATIONAL CHANGE AND AERONAUTICAL ADAPTABILITY AMONG NAVY AND MARINE CORPS AVIATION TRAINEES
J.H. ASHBURN, U.S. Navy, Aerospace Medical Res. Lab., *Pensacola, Florida* 32512 (DN141807)

Past research and development has supplied the means of reducing attrition from undergraduate pilot training and for identifying poor training risks at relatively earlier points in training. There still exists, however, a significant attrition rate of which about half can be associated with motivation and aeronautical adaptability. Part of this attrition problem can be attributed to individual idiosyncratic characteristics yet to be measured and part to the impact of external change or lack thereof upon the applicant/trainee population. The objective of this work unit is to develop improved methods for measuring and predicting motivational change and aeronautical adaptability as related to attrition from and performance in training and operations.

Together with present measures of cognitive aptitude and interest in flying new measures of aptitude, attitude, psychomotor and perceptual skill, personality, and physical and psychophysiological characteristics will be assessed, separately and in combination, for prediction validity against attrition from and performance in different stages and pipelines of naval air training and ultimately against fleet criteria. The effects of identifiable cultural and organizational factors upon attrition will be considered.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Aerospace Medical Research Lab.

6.0011, INVESTIGATION OF CAUSES OF MILITARY AIRCRAFT ACCIDENTS INVOLVING PILOT VERTIGO/DISORIENTATION
W.C. HIXSON, U.S. Navy, Aerospace Medical Res. Lab., *Pensacola, Florida* 32512 (DN477050)

This project is a joint interservice research effort to reduce the number of aircraft accidents that will occur in future Army/Navy flight operations as a result of pilot vertigo/disorientation experiences.

Primary emphasis is to be placed on the review and analysis of aircraft accident case history reports so as to determine the relative incidence, dollar cost, personnel cost, mission degradation effects, and operational causes of all forms of orientation-error accidents. The resultant data will be utilized to (1) define the actual magnitude of the orientation-error problem in military aviation; (2) pinpoint specific operation aircraft or tactical maneuver situations requiring priority attention; (3) formulate methods to improve the acquisition of operational data describing the sensory illusions and system etiology of inflight spatial disorientation experiences; (4) and to develop instructive materials and recommendations for corrective/preventive action.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Aerospace Medical Research Lab.

6.0012, SCALING, VALIDATION AND EXTENSION OF THE HEAD-SPINE MODEL
T.B. BELYTSCHKO, Univ. of Illinois, School of Engineering, *Chicago, Illinois* 60680 (DF317200; F33615-76-C-0506)

The present program is for the purpose of providing the Air Force with a comprehensive and definitive analytic computer model of the human head-spine system with a capability of predicting probabilities of various modes of injury to the spinal column resulting from externally applied impact forces. Additionally, analogous models - based on the same formulation as for the human model - will be developed for the rhesus monkey, chimpanzee and baboon. These latter models will be used as a means of validating model formulation and will also provide a means of scaling experimentally obtained biodynamic data from the above-mentioned animals to man.

Modifications and refinements will be made in the head-spine model developed under contract no. F33615-74-C-4014 to provide an injury assessment capability for any given excitation of the head-spine system. To achieve this, recorded injuries to the head-spine system resulting from high-level forces will be identified. Appropriate physical mechanisms for these injuries will be defined and identified with corresponding model mechanisms. Injury probabilities will be associated with each injury mechanism. To develop analogous models for non-human primates, geometric and material property data will be assimilated for these species - including disc properties, facet orientations and geometric shape and size of vertebral bodies - and incorporated into the general head-spine model to provide the respective analogous models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0013, BIRD STRIKE ANALYSIS
T. BELYTSCHKO, Northwestern University, Graduate School, *Evanston, Illinois* 60201 (DF323270; F33615-77-C-0529)

The possible impact of external objects - especially birds - on aircraft canopies poses a difficult problem for the system designer who must try to assess and maximize crew safety while at the same time optimizing conditions for crew operational performance. The present program seeks the development of an analytic computer-based capability for the analysis of human head-neck response (with and without helmet) and the prediction of probability of injury (or level of incapacitation) resulting from impact of objects on the canopy of aircraft -particularly birds. The result of this development will have particular applicability in the evaluation of the recently adopted highly resilient integrated aircraft polycarbonate plastic shell canopy used in the F-16 and being considered for other future aircraft. The analytical methodology will also have applicability in the evaluation of the more conventional canopy structures such as used on the F-15, A-10 and the F-111.

The two modeling methodologies consisting of the head-spine model (as described in AMRL-TR-76-10 and updated and modified under current Air Force Contract F33615-76-C-0506 with the University of Illinois at Chicago Circle) and finite-element models of shell structures appropriate for the geometric and material properties of currently considered polycarbonate aircraft canopy/windshield structures will be utilized in this study. They will be combined to form one computer program which will provide predictions of a total dynamic event consisting of a com-

pliant object striking an aircraft canopy, transmission of momentum through the canopy interface to the helmeted human head, gross response of the human head and transmittal of stresses in the cervical and thoracic spine. An index for extent of incapacitation of the pilot shall be predicted. Variability of conditions to be considered shall include mass, compliance and angle of incidence of the striking object, provisions for moderately varying the geometry of the canopy structure and allowing for different material properties, initial positioning of the human torso and head in the cockpit and various helmet elastic and damping properties.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0014, GENETIC BASES FOR THERMOPHILY - ORIGINS OF THERMAL STABILITY AND MEMBRANE FUNCTION

E.J. JOHNSON, Tulane University of Louisiana, School of Medicine, *New Orleans*, *Louisiana* 70118 (NCA 2-800801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0015, DEVELOPMENT OF HUMAN PERFORMANCE MODELS FOR MAN-MACHINE SYSTEM SIMULATION

R.W. PEW, Bolt Beranek & Newman Inc., *Cambridge*, *Massachusetts* 02138 (DF042440; F44620-76-C-0029)

AF function - whatever the precise form of the final RPV operational capability, timely and reliable performance of human components will be critical to mission success. The most responsive design of an RPV system requires valid data on the functioning of the human operation. Deficiency - previous efforts have not provided information specific enough for detailed design of the total complex of rules, procedures and decision-making which must support new, more stringent system functions. Consequently, the task of combining human performance data in the solution of man-machine reliability equation and, thereby, of assaying alternative system configurations cannot be satisfactorily accomplished. Objective - BBN proposes to develop and test improved models of human performance. These models are to be integrated with structure models of the tasks associated with control of RPV systems being developed by AMRL. How research contributes -promising models in sufficient detail for AMRL implementation and evaluation of their usefulness will identify subsystem model parameters having greatest influence on system performance. By exercising these models, systems engineers can predict the effects of changes in system parameters before proceeding to full-scale simulation efforts and the operational evaluation of prototype systems.

Modelling studies will be conducted in collaboration with AMRL/Human Engineering Division personnel to explore quantitatively and in detail several key issues in model development. Recommendations and guidelines will be prepared concerning the most suitable approaches, and resolving ambiguities in the application of simulation models in future model development programs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0016, SENSORY MECHANISM MODELING STUDY

D. SHENNA, Whittaker Corporation, *Waltham*, *Massachusetts* 02154 (DF227900; F33615-76-C-0039)

To investigate, develop, and validate a model of human motion and force sensory mechanisms including the visual, vestibular, and somatic systems and their respective interactions in order to exploit artificial means of stimulation for improved simulation of the flight environment. This multisensory model will be used to determine the motion and force simulation requirements for current and future flying training simulators.

Recent data and models of the various motion and force sensory mechanisms will be compiled and where the sensory models are found to be deficient or nonexistent new models will be developed. These models will then be integrated and implemented on a computer to produce a composite multisensory model. The composite model will then be exercised and tested and validated using existing psychophysical data and data derived from specialized motion devices. The model will then be stimulated by generated flight and simulator inputs in order to determine which sensory mechanisms are being exercised and to what degree under various conditions. From this, information on new and the optimum use of existing motion and force cuing devices will be developed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0017, RESEARCH ON LIMB FLAIL DESIGN LIMITS

E. GROOD, Univ. of Cincinnati, Graduate School, *Cincinnati*, *Ohio* 45221 (DF319910; F33615-76-C-0511)

Design criteria are required to define the tolerance of the human body to the aerodynamic forces encountered during emergency escape from high-speed aircraft. Limb flail injuries represent a major cause of injuries resulting from use of ejection seats. The objective of this effort is to initiate the definition of the tolerance and failure limits of the musculoskeletal system of the human leg, specifically the knee joint, to high mechanical stress conditions such as occur in emergency egress, windblast conditions and hard or impact landings.

Components of the human knee joint, specifically the femur-anterior cruciate ligament-tibia system will be tested in translational extension at high strain rates and the results compared with rhesus monkey results previously obtained (AMRL-TR-73-117). The response and failure limits of the intact human knee to rapid rotation (tibia rotation relative to the femur) will also be determined. Special emphasis will be given to the selection, preparation, and mounting of specimens to assure optimal simulation of the live, healthy human leg.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0018, HELMET-MOUNTED DISPLAY PROTOTYPE DEVELOPMENT

D.W. ANDERSON, U.S. Air Force, Human Resources Laboratory, *Dayton*, *Ohio* 45433 (DF228220)

To develop a prototype helmet-mounted, virtual image display system. Current virtual image visual display systems for ground-based simulation rely on large, expensive optical elements to provide an image and a mosaicked configuration to provide a wide field-of-view. The helmet-mounted display has the potential to reduce costs due to its small size. It will also conserve image generation resources, since only the portion of the scene in from of the pilot's eyes need be generated.

On 1 Oct 76, AMRL will initiate a program to develop a visually coupled airborne systems simulator (VCASS). AFHRL/AS will participate with AMRL in the development of the helmet-mounted display which is part of the VCASS program. A prototype helmet-mounted display system will be jointly developed. Since VCASS is intended for engineering applications, it is expected that further work by HRL will be required to develop the potential of the helmet-mounted display system for visual simulation applications. Milestones: initiate development of improved components, 1 Oct 76, demo of visually coupled system as hemisperical HUD, 1 mar 77, VCASS demo for air-to-ground, 1 Jan 78, VCASS demo for air-to-air, 1 Dec 78, full VCASS demo, 1 Jun 79, AFHRL 6.3 effort initiated, 1 Oct 79.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0019, NEW OPTICAL COUNTERMEASURES TECHNIQUES EVALUATION

G.D. CALLIN, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton*, *Ohio* 45433 (DF318870)

Optically aided and direct visually sighted antiaircraft artillery and surface-to-air missile systems are remarkably effective against aircraft. Various methods of counter-effective human sighting performance have been suggested including several which are related to dynamic visual illusions. This effort will

determine the suitability of these concepts to degrade tracking performance of an antiaircraft artillery operator. The objective is to discover a method to minimize attrition of our aircraft to ground fire.

Several approaches to the problem are being considered. The most promising will be identified and tested in a realistic simulation utilizing trained subjects tracking standard flight trajectories on the Air Force Optical Countermeasures Simulator. Investigation of approaches most likely to be successful now is in progress.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0020, CHARACTERIZATION, DETECTION AND MONITORING OF CHEMICAL HEALTH HAZARDS
D.L. GEIGER, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF312700)

To identify and quantitate contaminants and potentially hazardous effluents generated by AF operational and test activities including the products of thermal degradation of chemicals, materials, and propellants. To perform toxic hazard evaluation of these data as they relate to operational exposure of AF personnel and/or environmental impact of use and disposal of such materials. This work is requested by AFSC laboratories, ASD, SAMSO and AFLC.

Thermogravimetry (TG) is used to study chemical stability and degradation rates of AF non-metallic materials used in confined environments. Thermal breakdown products are separated and quantitated by gas chromatography (GC) and identified by mass spectrometry (MS). The methodologies employed are the combined techniques of GC-MS, TG-GC, and TG-GC-MS. Additional analytical methods such as pyrolysis gas chromatography are used to evaluate potential environmental hazards as deemed necessary.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0021, COGNITIVE ASPECTS OF VISUAL PERFORMANCE
F.E. GOMER, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF320900)

The fundamental goal of this program is to specify the manner in which task requirements affect the observer's ability to acquire and process visual information. Research findings will be used to aid design engineers in configuring display systems so that they effectively complement the specific cognitive functions of the operator. Products of this work unit support AFSC development goals TC-1, TC-7, C3-3, and MS-4.

Data will be provided concerning recognition and identification functions for symbolic and imagery displays. Performance measures will be derived from conventional psychophysical, signal detection, and transient VER techniques. Efforts will be toward: (a) determination of the extent to which late components of the ensemble averaged visual evoked response (VER) reflect the observer's interpretation of displayed information, (b) real-time detection and classification of VERs related to information processing, (c) analysis of eye movement behavior underlying visual perception, and (d) understanding of how physical stressors degrade extraction and processing of visual inputs. Several experiments will attempt to successfully detect single-event VERs through digital filtering of scalp-recorded brain activity. Computer pattern recognition procedures will be implemented to partition the individual filtered responses into categories on the basis of differences either in the physical properties of the eliciting stimuli or in the outcomes of decision-making operations. A contract (WU 71841112) with Purdue University supports this effort. The SRI eye-tracker will be used to determine how particular task requirements affect patterns of visual search. It will also be employed to trigger VERs following eye fixations. Outyear work units (the limits of effective visual information processing under vibration and acceleration, will be determined. Performance to be monitored includes visual search, motor responding, and psychophysiological activity. This program will be coordinated with BBI. Equipment and personnel associated with the display lab, the image metric lab, and the visual response lab will contribute to all research endeavors. Results will be of value to WUs in RTEs A1, A4, B3, B4, and C5, as well as to other WUs in RTE A3.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0022, WORKLOAD ASSESSMENT METHODS
R.L. HANN, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321020)

The objective of this work unit is to develop prototype task batteries for assessing and predicting operator workload dictated by mission/system demands. The performance metrics produced will allow comparable quantitative measures of workload demands for a variety of crew member information processing functions essential to advanced aeronautical systems. A secondary objective is to insure that the task battery procedures, metrics, and hardware/software specifications are mutually compatible with the laboratory simulation environment as well as the development test and evaluation (DT and E)/operational test and evaluation (OT&E) environments. This effort supports AFSC development goals, TC-1, TC-2, TC-7, C3-3, RI-1, and MS-4.

Selected tasks from advanced digital information processing systems currently in conceptual or advanced development stages including DAIS, JTIDS, SDM, WMMCS, etc., will be analyzed in terms of man/computer information processing requirements. Critical problems will be identified from requirements and defined in terms of man/computer interface design for maximizing information transfer and throughput rates as determined from anticipated mission data rates. Human information processing measures and stages based on recent performance-theory developments will be analytically mapped onto the system data processing requirements. The results will be tested through experimental operator-in-the-loop part-task and mission segment simulations on the HESS. The resultant data and transfer functions will be integrated into the design of prototype task batteries for assessing workload as a function of task/equipment design and mission/system demands.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0023, CONSULTATION ON TOXIC ECOLOGICAL EFFECTS AND ENVIRONMENTAL IMPACT
R.C. INMAN, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF320480)

The obejctives of this effort are: (1) to assist users of Air Force chemicals with interpretation of data related to the ecological aspects of their operations, (2) to lend technical assistance and provide professional advice to organizations preparing environmental impact statements or assessments, (3) to assist the Surgeon General in responding to requests for review of criteria documents from NIOSH and EPA, and (4) to maintain contact with academic institutions, industry, and other governmental agencies in order to keep abreast of the state-of-the-art in environmental research.

To provide technical and professional advice to any Air Force organization preparing environmental impact statements or assessments when chemical pollution is a major concern. Close liaison will be maintained with EPA to keep abreast of environmental quality standards and criteria requirements. When the National Academy of Sciences establishes its board on environmental quality, continuous contact will be established for assistance in setting environmental quality standards.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0024, HUMAN CAPABILITIES IN INFRASOUND
D.L. JOHNSON, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321360)

Various AF noise environments contain high-intensity acoustic energy in the frequency range below approximately 16 Hz (infrasound). Although this very low frequency energy has little effect on hearing it may adversely influence physiological functioning, psychomotor and cognitive performance. The objective of this research is to systematically investigate the effects of

infrasound exposures on the capabilities of human subjects to perform selected tasks. The threshold of these effects, the nature and extent of the interference and the overall performance limits will be defined in terms of the acoustic exposures. This effort will provide support for the whole body exposure effects standards sections in AFR 161-35.

The approach is to systematically examine the effects of infrasound on a variety of tasks, performed by human volunteers, that might show differential effects due to the very low frequency energy. The nature and difficulty of the tasks (psychomotor, visual search and cognitive) will be varied together with the frequency, duration and intensity of the infrasonic stimulus in an effort to identify variables in the stimulus, task or subject that might result in reduced human capabilities. A substantial technology base describing human performance in infrasound will be realized when these results are integrated with those from earlier efforts. This work is possible only because of the unique dynamic pressure chamber at AMRL.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0025, MODEL OF BIOMECHANICAL RESPONSE IN MOIFE

I. KALEPS, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321250)

This work unit is part of an effort whose end product will be a predictive model of pilot tracking performance in low-level, high-speed flight. Fundamental to achieving that goal is the construction of a biomechanical model of the feedthrough of vibration through the musculoskeletal system and into the aircraft system. That is the objective of this work unit. This modelling effort will also contribute to a related effort whose product will be a predictive model of visual performance in low-level, high-speed flight.

For the most part, the data needed for this modelling effort will be collected from vibration experiments conducted under work units 72310180 and 72310182. Fairly adequate models already exist for the feedthrough from the shoulder to the control stick. The major emphasis of this effort will be to model the transmission of vibration from the buttocks through the vertebral column to the shoulder and to the head.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0026, HEARING RISK DUE TO COMMUNCIATION SIGNALS

R. MCKINLEY, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF322960)

Effective voice communication in high-level noise environs may require air and ground crew personnel to increase the intensity of the signal to a level that is damaging to hearing. The objective of this effort is to measure ambient noise and voice communication signal levels under standard AF communication devices during a variety of air and ground operations, to quantify the hearing damage risk and to consider alternate operating procedures that eliminate such risk. This effort will benefit the SQ, ASD, Life Support SPO, base bioenvironmental engineers, as well as air and ground crew effectiveness and safety.

The approach incorporates the field measurement of the acoustic signals under standard AF voice communication devices in a wide variety of air and ground operational environments. Measurements will utilize a precision miniature tape recorder and miniature microphone positioned at the ear under the communication devices. Data will be analyzed in the laboratory to identify operational situations with the risk potential, factors contributing to the problem and possible remedies.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0027, EVALUATION OF INTELLIGIBILITY OF TALKING PERIPHERAL COMPUTER

T.J. MOORE, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321500)

This work unit has as its objective the evaluation of the intelligibility of a synthetic voice output from a computer. A computer peripheral with voice output will have a number of applications in logistic areas, as well as providing a direct voice link from radar-computer to pilot.

This work unit encompasses the in-house work that accompanies the contractual effort which will produce a computer peripheral with voice output (72330331). It includes the revision of existing software algorithms for speech synthesis to improve intelligibility and operating speed. It also includes the running of intelligibility tests (with listener panels) to measure the acceptability of both the software and hardware versions of the voice synthesizer.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0028, ONE-ON-ONE G/A ENGAGEMENT MODEL DEVELOPMENT

W.C. SUMMERS, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF322490)

Develop a ground-to-air attrition model for the Soviet ZSU-23-4 antiaircraft artillery weapon system. This model will include an optimal control azimuth and elevation human operator submodel, an optimal control radar range human operator submodel, a model of crew discrete decisions including mode switching, an optimal control model of engagement tracking with tracers, and a model of the target acquisition process.

Evaluate exploitation documents, existing software, software under development (e.g., B.D.M. software) and field test data. Extract weapon subsystem descriptions and estimates of their inherent weapon system modelling errors. Develop software which predicts the performance of the ZSY-23-4 AAA weapon system with minimal error while maintaining run times compatible with large data base reduction on the CDC 6600 and comparable computers. Integrate human operator tracker models as completed under other 689304 work units.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0029, WINDSCREEN ANALYSES

B.D. TARGOVE, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321130)

To provide a technical document which analytically defines and treats the current Air Force visual effects of windscreen problems. An optical analysis will classify, define and describe optical characteristics, and will suggest new optical measures, test criteria, and visual variables for lab investigation. A visual performance analysis will treat criteria operational tasks analytically to determine the relationships to visual and optical factors and measures. A visual quality inspection analysis will be made to categorize and quantify optical defects found in visual inspection processes.

Optical analysis: optical characteristics and specification techniques will be catalogued, defined and analyzed in terms of measurement procedures, equipment, measurement interrelationships and geometric effects. Visual performance analysis: critical mission segments will be determined and criterion tasks selected which relate to optical variables, visual cues will be related to these tasks and to suggested laboratory visual measures, the relationship between operational tasks and various optical areas of the windscreens requiring differential optical specification will be determined. Visual quality inspection quantification: the optical defect categories and lexicon used in visual inspection will be captured and quantified.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0030, CENTRAL AND PERIPHERAL MECHANISMS UNDERLYING CARDIOVASCULAR DECONDITIONING IN THE UNANESTHETIZED PRIMATE

H.L. STONE, Univ. of Oklahoma, School of Medicine, *Oklahoma City, Oklahoma* 73104 (NSG 2282)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0031, APPLIED PREDICTIVE MODEL FOR HUMAN EXPOSURE TO THERMAL STRESS IN USAF OPERATIONS
E.H. WISSLER, Univ. of Texas, School of Engineering, *Austin, Texas* 78712 (DF320430; F33615-77-C-0602)

This effort is designed to develop a computer model for predicting human response to the thermal stresses encountered in USAF operations. Use of such a model should permit prompt answers to questions from the field without the need for human experimentation, and should also serve to pinpoint critical areas where further investigation is indeed required. Although a number of programs on thermoregulation are already in existence, none is immediately suitable for USAF application. This effort will produce either a new model or a modification of an older one for this purpose.

The contractor will develop a digital computer program for predicting human response to thermal stress. The objectives of this contract are: (1) to conduct a review of existing models to determine their suitability for this application, (2) to write a new program or modify an existing one to meet the technical requirements, (3) to provide computer programs written in Fortran, compatible with USAFSAM computer hardware, and (4) to compose a technical report summarizing the literature review and citing the experimental findings which form the basis for the model.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0032, STUDY OF BONE AND MUSCLE PROTEIN DEGRADATION
N. DIFERRANTE, Baylor College of Medicine, School of Medicine, *Houston, Texas* 77025 (NAS 9-15478)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0033, DEVELOPMENT OF AN ADVANCED OPERATIONAL ANTI-G VALVE
R.R. BURTON, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322320)

To design, fabricate and test experimental anti-g valves which will improve g-protection during exposure to aerial combat maneuvers. Anti-g valves developed in-house and through contract will be tested for improved g-protection using standard USAF anti-g suits. Anti-g valves found superior to the operational USAF anti-g valve will be documented and their specifications will be transferred to ASD/AEL.

Various experimental anti-g valves will be tested on human subjects exposed to various g profiles using g onset rates up to 6 g/sec. Criteria for evaluating suit inflation will be considered relative to g onset, several physiologic parameters, and subjective evaluation. These results will be compared with those obtained using the standard USAF anti-g valve. Specifications of valves with superior operational characteristics will be handed off to ASD/AEL.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0034, RESCUE AND RECOVERY EQUIPMENT
G.L. FROMME, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322100)

To test and evaluate newly developed commercial or in-house items of medical material to determine their effectiveness in the Aerospace Rescue and Recovery Service (ARRS) medical missions. The Biomedical Systems Branch has an ongoing program to evaluate medical material items to satisfy identified operational requirements for the ARRS. Performance criteria have been established to insure that medical equipment items meet stated operational requirements of the mission. Current state-of-the-art of medical material technology will be continually assessed.

The test program normally consists of six major areas: patient-user safety, operational specifications, environmental effects, electrical and mechanical characteristics, and human factors. Each area is subdivided into specific engineering tests or evaluations. Upon completion of the test program, a written report stating whether the item is or can be made acceptable is sent to the field. The information is kept on file and is updated or modified as user reports are recieved. This is a continuation of part of the work formerly documented under 7755-15-02.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0035, AMST TOXIC GAS STUDIES
R.C. LIGDAY, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322640)

This effort will determine chemical composition of the cabin breathing environment in the advanced medium short-takeoff-and-landing transport (AMST) during simulated open-door flight operating modes. This support was requested by the AFFTC Human Factors Group to quantitate engine backwash into the flight deck and cargo compartment in the in-flight flap-down configuration. This continuation of the effort documented under 7164-16-28 will implement the technical planning objective directed by HQ AMD.

Flight testing will be done at Edwards AFB on both the YC-15 and YC-14 aircraft. Continuous measurements will be made of the cabin concentration of carbon monoxide, oxides of nitrogen and exhaust hydrocarbons during open-door flight maneuvers.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0036, WINDSCREEN EVALUATION - F-111 AND GENERIC
W.F. PROVINES, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321960)

High-performance aircraft windshields designed to withstand bird impact have evolved into thick, curved, laminated new materials compositioned transparencies of large dimensions. This effort will provide optical measurements and visual performance capabilities of trained observers through a variety of segments and full-scale windshields characteristic of USAF inventory and emerging aircraft. Test results will provide scientifically based tolerance values for windshield specification writers and guidance to windshield manufacturers on realistic quality control measures.

An optical laboratory has been established. The facilities and equipment provide capability for accurate determinations of transmission, haze, deviation, distortion and multiple image production for any aircraft windshield provided for study. Visual performance testing in the physiological optics laboratory can be conducted on acuity alteration, stereopsis changes, and eikonemetry (magnification) effects produced by transparencies with known optical defects. Coordination with AMRL personnel engaged in related optical-visual performance studies will be maintained. Efforts previously documented under work units 7755-09-01 and 7755-09-04.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0037, HUMAN BREATHING SIMULATION TECHNOLOGY FOR OXYGEN GENERATOR AND DELIVERY EQUIPMENT, DEVELOPMENT TEST AND EVALUATION
R.F. STRIBLEY, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF323180)

Accurate testing and evaluation of respiratory life support concepts and equipment requires a continuous monitoring and simulation capability. Enhancement of human safety and acquisition of more meaningful performance information can be accomplished with the use of a metabolic simulator designed to mimic human function corresponding to variable states of stress. Peripheral control of such a simulator should be interfaced to provide long-term programming of specific test sequences. Physiologic conditions including hyperventilation and acute exer-

cise response should be attainable on a simulated basis, with appropriate attachments provided for oxygen regulators and masks during exposure to altitude. A remote controller should also provide a tape playback and control facility to enable simulation of actual inflight situations as recorded by the inflight physiological data acquisition system.

Two partially completed human breathing simulators will be evaluated for completion feasibility. Completion of the simulators will be performed by in-house personnel. Evaluation and testing of the simulators will be performed using previously obtained in-flight data from the in-flight physiological data acquisition system. The completed simulators will be used in the testing of fluidics oxygen regulators and chemical defense masks, as well as on-board oxygen generating systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0038, THALLIUM 201 MYOCARDIAL IMAGING
J.H. TRIEBWASSER, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321730)

To develop a noninvasive method for detection of myocardial ischemia in USAF flying personnel.

Patients seen by the Aeromedical Consultation Service for evaluation of abnormal exercise tests will be injected with 2 uCi thallium 201 at maximum exercise. Statis scans will be made after an eight-minute recovery period. Scans will be interpreted for areas of ischemia. The results of the scan will be compared to results of coronary angiograms to determine whether significant coronary artery disease can be detected on scan.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0039, MEASUREMENT OF RFR POWER DISTRIBUTION
A.W. GUY, Univ. of Washington, School of Medicine, *Seattle, Washington* 98122 (DF318740; F41609-76-C-0032)

High-level national concern over adequacy of existing RF safety standards have highlighted the need to be able to accurately define experimental exposure fields, insure intercomparability of power deposition and mechanism of measured distributions in experimental animals. This effort will investigate ground plane and position effects on power absorption in several man models at U. Washington and at USAFSAM/RA. To intercompare field measurement techniques used at U. Washington and those used at USAFSAM, together with comparison of theoretical and measured distributions in experimental animals exposed in both facilities. To design and construct an exposure system for cell or tissue cultures when fields within culture can be exactly specified. To demonstrate utility of the culture system by exposing freshly isolated primate lymphocytes with and without stimulating antigens.

University of Washington personnel are to bring thermographic equipment and field measurement devices to USAFSAM to compare their measurements with those at USAFSAM. Killed animal models and physical models are to be examined after exposure to a variety of frequencies at USAFSAM and U. Washington including the JF band coax, near field synthesizer and U. Washington resonant cavity, was well as provisional examination of the fields generated by the multiple-frequency exposure apparatus at SAM. An exposure cell is to be constructed from readily available materials and its utility demonstrated by exposure of freshly isolated lymphocytes to fields calculated for an equivalent field in man models exposure to a variety of field geometries.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0040, OPERATION OF A BIOMEDICAL APPLICATIONS TEAM
W.N. FETZNER, Univ. of Wisconsin, Graduate School, *Madison, Wisconsin* 53706 (NAS 5-24385)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, COMPUTER SIMULATION OF INVISCID TRANSONIC FLOW
V. DROBOT, Univ. of Santa Clara, School of Science, *Santa Clara, California* 95053 (NCA 2-685803)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

7.0002, STOCHASTIC FILTERING AND CONTROL
T.E. DUNCAN, Univ. of Kansas, School of Liberal Arts & Sci., *Lawrence, Kansas* 66045 (DF046660; AF-AFOSR-3177-77)

AF function - the study of Air Force aerospace systems and conventional systems. Deficiency - the control of a linear system is a mathematical straightforward task. However most physical systems are inherently nonlinear and need new techniques for control. Objective -the objective of this research is to investigate the stochastic filtering and control of stochastic systems which are modelled by stochastic differential equations in the tangent bundle of a smooth manifold. How work contributes - success here would result in improved performance of physical Air Force systems.

Research will proceed in various problems in stochastic filtering and control in the setting of some manifolds, specifically models given by stochastic differential equations in the tangent bundle of a Riemann manifold. Compact Riemann manifolds will be investigated first to insure that there are no finite escape times for the stochastic differential equations. This manifold formulation should allow for the identification of equivalent filtering problems in different manifolds and control for processes in Euclidean n-space and therefore the notion of stochastic integrals in a manifold should also be important for the solutions of stochastic filtering and control problems in a manifold. The investigations of manifold-valued stochastic integrals will be continued.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0003, STUDY OF MAJOR ARCHITECTURAL DESIGN ISSUES ASSOCIATED WITH THE DEVELOPMENT OF A MISSION-ORIENTED DISTRIBUTED COMPUTING SYSTEM
A.K. AGRAWALA, Univ. of Maryland, School of Engineering, *College Park, Maryland* 20740 (NAS 5-24407)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

7.0004, CONCURRENT PROCESSING SYSTEMS STUDY
T.Y. FENG, Wayne State University, School of Engineering, *Detroit, Michigan* 48202 (DF728230; F30602-76-C-0282)

The objective of this effort is to conduct exploratory development in the design and use of concurrent processing systems for Air Force data processing needs. Four broad areas of computing technology are to be emphasized, configuration systems, programming languages, modeling and performance evaluation, and design specification languages.

To investigate and develop techniques and procedures for grouping microprocessors and develop program routines which will cause these groups to act as a variety of functional units (ALU, push down stack, index register, etc.). Using the features of the data manipulator and the STARAN associative processor develop techniques for interconnecting the functional units to form concurrent computer architectures. Using the features of the NANODATA QM-1 develop specification and compiler techniques for controlling all elements of the above system such that a user's HOL description of a problem solution and an

architecture specification can be entered into the system and the problem then executed as if it were on the specified architecture. Using the elements of the system, develop techniques for performance monitoring. Develop concurrent processor application programs. A solid background in parallel processor system and in the development of parallel processor algorithms is required.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

7.0005, DEVELOPMENT OF A COMPUTERIZED ALGORITHM FOR ESTABLISHING HARMONIC BALANCE
J.R. MITCHELL, Mississippi St. University, School of Engineering, *Mississippi State*, *Mississippi* 39762 (NAS 8-32810)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

7.0006, NONLINEAR OSCILLATIONS BY TOPOLOGICAL AND FUNCTIONAL ANALYTIC METHODS 12981-M
J.C. SCANLON, Rutgers The State University, School of Arts & Sciences, *New Brunswick*, *New Jersey* 08903 (DA0K5572; DAHC04-75-G-0148)

To determine useful conditions for the existence and stability of periodic and almost periodic solutions of ordinary and functional differential equations, and to study bifurcation phenomena in nonlinear problems. Relevance - the questions of existence and stability of periodic solutions of nonlinear problems arise in a variety of areas, e.g., flap-lag stability analysis of helicopter rotor blades. These problems are aggravated when hysteresis or material memory introduces a time lag into the system. Bifurcation studies serve a dual role, supporting the theoretical existence studies mentioned above and unraveling such practical problems as buckling and sudden changes of structural response due to the variation of a physical parameter.

To formulate these problems in an abstract function space and apply the methods of topological degree theory to the resulting operator equations.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, RESEARCH ON HIGH-TEMPERATURE ELECTROCRYSTALLIZATION TECHNIQUES FOR CRYSTALS WITH SEMICONDUCTING PROPERTIES
R.A. HUGGINS, Stanford University, Center for Materials Research, *Palo Alto*, *California* 94305 (DN675015; N00014-75-C-1171)

To conduct research on elevated temperature electrochemical crystallization techniques for the preparation and evaluation of materials having distinct semiconducting properties. Suitable electrolytes and electrodes for electrodeposition will be determined in terms of structures and quality of deposits. Physical and electrical properties of such materials will be determined by research teams both at Stanford and elsewhere, as they are developed.

Electrodeposition of InP, GaP and of ternary alloy (e.g., CdGeP2) will be conducted. Electrolytes/electrodes selected will be evaluated in terms of crystal growth processes. Crystals will be examined via X-ray, electron microprobe, optical and scanning electron microscopy. Techniques for the development of continuous crystal growth (czochralski method) to yield shaped crystals will be undertaken, and purification processes and the role of introduced doping elements during crystal growth will be examined.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0002, VELOCITY MEASUREMENTS BY LASER RESONANCE FLUORESCENCE FROM A SINGLE ATOM
C.Y. SHE, Colorado State University, School of Natural Sciences, *Fort Collins*, *Colorado* 80523 (NSG 2287)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0003, RELATIVISTIC ASTROPHYSICS AND GRAVITATION THEORY
D.M. EARDLEY, Yale University, Graduate School, *New Haven*, *Connecticut* 06520 (PHY76-82353)

With the probable discovery of black holes by X-ray astronomers, Einstein's general relativity has become even more an indispensable part of astrophysics, in addition to its role as a successful physical theory. The Yale group will conduct a many-sided investigation of the theory and its astrophysical applications. They plan to calculate X-ray emission by hot plasma near a black hole, especially through inverse Compton scattering, which probably dominates in the source Cyg X-1. In particular they plan to refine the hot disk model, and also formulate models for X-ray sources in globular clusters. Several well-posed problems on fluid disks and flows near a black hole will be investigated.

One of the most challenging open problems is to understand in detail the gravitational collapse of a non-spherical stellar core to a black hole or neutron star. Here, they will also carry out theoretical investigations of perturbation theory and the initial-value problem, some of which will apply to collapse.

They will explore further tests of the principle of equivalence, the cornerstone of Einstein's theory, by observations of orbits of neutron stars, notably PSR 1913 plus 16. Quantum particle creation by gravitational fields will be studied.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0004, ACOUSTIC ANALYSIS OF THE PROPFAN
H. LIEBOWITZ, George Washington Univ., School of Engin. & Appl. Sci., *Washington*, *District of Columbia* 20037 (NSG 1474)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0005, MATERIAL SUPPORT TECHNOLOGY - STRUCTURAL DETERMINATION OF SOLID SURFACES
D.T. PIERCE, U.S. Dept. of Commerce, Optical Physics Division, *Washington*, *District of Columbia* 20234 (DN675520; N00014-77-F-0013)

In many materials for use in Navy systems, such as semiconductors for electronic components or metals for catalysis, the structural properties of the surface are intimately related to the electronic properties and surface reaction rates. New surface analysis techniques will be developed to help reveal the regular atomic structural properties of metals and semiconductors and of thin overlayer materials.

A spin polarized electron source will be incorporated into a low-energy electron diffraction (LEED) system for use in the study of the surface structure (crystallography) of metals and semiconductors. It has been suggested that polarization effects in LEED experiments could reduce the ambiguity in the resulting surface structure analysis and provide clarification to understanding the factors involved in the scattering processes. The investigator has developed a unique, high-current spin polarized electron source which will be evaluated as a tool for studying solid surfaces. Since the most accurate data available and the most complete analysis results are for metals, the first attempts will study these metals to provide comparison information. Other materials to be studied will be the metals with thin overlayers of absorbed atoms and then a comprehensive study of compound semiconductor surfaces, i.e,. ideal, reconstructed, oxidized, and those covered with thin overlayers.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0006, THEORETICAL STUDIES OF SOLIDS
K.L. NGAI, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN220077)

To obtain a basic understanding of the physics and chemistry of semiconductors, as well as ferroelectrics, pyroelectrics, and other materials exhibiting phase transitions. Those aspects involved in providing the development and characterization of materials needed for high performance and/or less expensive electronic devices and components are emphasized.

Many-body techniques are used in the study of the lattice and electronic properties of semiconductors and pyroelectric materials in both the bulk and surfaces. Numerical calculations are performed for comparison with experimental data. Electronic states including bands and defects are calculated using pseudopotential and OPW techniques.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

8.0007, ACCELERATOR BASED METHODS OF AEROSOL ANALYSES FOR BERYLLIUM (ABBREV)
J.W. NELSON, State University of Fla. Sys., School of Arts & Sciences, *Tallahassee, Florida* 32306 (R804276-01; G712B-BA-12)

Rapid quantitative determination of beryllium via proton scattering will be investigated as a function of both scattering angle and bombarding energy. Simultaneous observation of other elements using wavelength dispersive X-ray analysis will also be evaluated. Extension of the X-ray technique in order to determine oxidation states by measurement of chemical shifts and differential population of satellite lines will be examined.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab.

8.0008, MATERIAL SUPPORT TECHNOLOGY - FAR INFRARED OPTICAL AND MAGNETOOPTICAL STUDIES OF SEMICONDUCTORS
S. PERKOWITZ, Emory University, School of Arts & Sciences, *Atlanta, Georgia* 30322 (DN675255; N00014-76-C-0429)

The Navy has application for new semiconductor materials that offer improved performance in electronic systems. This program will provide measurements of optical properties of several materials in the far infrared region to provide information on the basic free carrier, lattice, impurity, and coupled interactions.

Far infrared optical and magnetooptical reflection and transmission measurements will be made in III-V, II-VI, and IV-VI semiconductors and their alloys with particular emphasis placed upon the III-V ternary solid solutions. These data will be utilized to investigate dielectric behavior, coupled phonon-plasmon modes, and free carrier properties of the materials. The role of multiple coupled oscillators in the dielectric behavior will be investigated. Polaron coupling and the role of plasma interactions in narrow-gap materials will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0009, ELECTRONIC STRUCTURE OF SOLIDS, SURFACES AND INTERFACES
A.B. KUNZ, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (DF043360; AF-AFOSR-2989-76)

AF function - Air Force functions such as communications, reconnaissance and surveillance, and command and control depends heavily upon modern electronic systems. Opportunity - improved performance in electronic systems can be achieved once a detailed and complete knowledge of electronic materials is available. Objective - to determine electronic structure, impurity states and surface properties of material with potential for improvement of current semiconducting devices. How work contributes - these studies will contribute to the understanding of the electronic properties of device materials and of the effects of impurities and their migration on these materials.

Unrestricted Hartree-Fock cluster calculational techniques will be used to study III-V binary, ternary and quaternary system, the surface structure of simple metals, and semiconductors and their response to simple impurities.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0010, THEORY OF SUPERIONIC CONDUCTORS
G.D. MAHAN, Indiana University, School of Arts & Sciences, *Bloomington, Indiana* 47401 (DF045800; AF-AFOSR-3106-76)

AF function - this proposed research primarily falls in the 5.3 research objectives which deal with electrical power from nonnuclear energy sources. In particular the use of superionic conductors as solid electrolytes has high potential for development of new batteries and energy storage devices. These batteries will be used for electrical power in manned and unmanned aircraft, satellites and space stations, as well as electrical power for unattended ground-based systems. Deficiency - substantial improvements are needed in organic and solid electrolytes to increase conductivity to that achieved in aqueous electrolytes. These solid electrolytes have a much wider temperature range and are needed to be used in new high-energy, high-charge and -discharge rates rechargeable batteries in future aircraft applications as well as space applications. Objective - the objective is to investigate two aspects of superionic conductors. First, models of phase transitions will be studied. Using methods developed by the PI calculations of phase boundaries will be made for the lattice structures which occur in many superionic conductors. New techniques to study the quantum lattice gas model will be developed and related to superionic conductors. The second aspect is to develop theories of light scattering from superionic conductors. Contribution - this research is a part of a comprehensive program in superfluids and superconductors.

It is proposed to use the periodic cluster method of Nauenberg and Nienhuis to find phase boundaries of three-dimensional systems. So far, all results using the cell method have been for two-dimensional structures. A trick to get around the computational problem has been found. If one takes cells of four spins, each three-dimensional lattice goes into a different one. One can form a cycle of the form SC-BCC-FCC-SC-etc. Each renormalization step has four spins with four cells which is easily handled by the computer. The results without the magnetic field have been done and accurate results for the transition temperature have been completed. It is proposed to add the magnetic field and do the cycle for this case. The fluorite lattice will be done first, since it is a structure which represents many superionic conductors, then some of the AgI compounds will be tried. It is also proposed to investigate whether the renormalization group method can be used to evaluate ionic conductivity. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0011, LASER-INDUCED STARK EFFECT (LISE)
R.W. GAMMON, Univ. of Maryland, School of Arts & Sciences, *College Park, Maryland* 20742 (DF042300; F44620-76-C-0033)

The Air Force is interested in effects associated with the transmission of laser radiation through the atmosphere. This research will assess the importance of the stark shifting of molecular absorption lines by high-intensity laser radiation. This effect, laser-induced stark effect (LISE), may have strong influence upon laser beam transmission through the atmosphere and on the intracavity properties of high-power lasers. In this effort, the resonant and near-resonant shifts for diatomic systems such as DF and CO will be calculated. These shifts are of interest for intercavity high-power density levels on the order of 10 to the 6 watts per square centimeter and greater. The main goal is to evaluate the current theoretical expressions of the magnitude of LISE for simple diatomic molecules using known values of the transition dipole matrix elements. It is expected that the calculated shifts can be used to identify LISE shifts in high-power diatomic molecular lasers and to predict changes in atmospheric transmission due to such shifts.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0012, REDUCTION AND UTILIZATION OF ENERGETIC PARTICLE DATA
P.M. HAGAN, Emmanuel College, Graduate School, *Boston, Massachusetts* 02115 (DF241450; F19628-73-C-0190)

AF function - communications and surveillance. Deficiency - insufficient knowledge of space environment. Research - organize and apply particle data. How research contributes - maps and monitors interaction of energetic particles with earth's magnetic field.

Satellite data in the form of raw magnetic data tapes will be reduced to meaningful entities such as energetic particle fluxes and sorted according to time, McIlwain l parameter, pitch angle, etc. This data will be tabulated and plotted as required. Computer programs will be written to provide models based on this reduced data.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

8.0013, EXPERIMENTAL SOLAR RADIO SPECTRUM ANALYZER
A. MAXWELL, Harvard University, School of Arts & Sciences, *Cambridge, Massachusetts* 02138 (NSG 7391)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0014, CO-ORDINATED ANALYSIS OF AURORAL DATA ON THE ATS FIELD LINE
R.H. EATHER, Boston College, School of Arts & Sciences, *Chestnut Hill, Massachusetts* 02167 (DF044480; F44620-76-C-0129)

AF function - the coupling of solar activity to the interplanetary medium to the earth's magnetosphere to the earth's atmosphere is of continuing importance to the Air Force mission for the effects on communication. One aspect of this, auroral studies, is particularly enigmatic and deserving of a high level of effort because of the adverse effects on operations in the polar regions. Deficiency - the method of transfer of energy in the form of corpuscular and electromagnetic radiation to the earth's upper atmosphere is unknown in detail. It is necessary to ascertain this nexus if a predictive capability is to ensue. Objective - this particular study will pursue an interpretation of data taken with various instruments along one field line of the earth's magnetic field. Ground magnetic, ground visual, satellite visual and satellite particle measurement will be combined to study the processes involved in auroral. Contribution - if a connection can be made between a measurable parameter, e.g., particle flux, magnetic field change, and subsequent transient activity in the earth's atmosphere, there may be the possibility of a predictive capability for these events arising.

This research will seek the following scientific objectives: (1) Comparison of trapped fluxes by ATS 5 and 6, loss cone flux measured by ATS 6, and auroral parameters measured at the feet of the ATS field lines. (2) The answer to the question 'are plasma injection events a result of plasma transport from the tail, or of in-situ acceleration.' (3) The study of enhanced loss cone fluxes and their sources. (4) The delineation of the extent of the auroral injection region. (5) Calibration of DMSP photographs in terms of the more commonly measured auroral spectral emissions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0015, EFFECTS OF HYDROGEN ATOM SPIN EXCHANGE COLLISIONS ON ATOMIC HYDROGEN MASER OSCILLATION FREQUENCY
S.B. CRAMPTON, Williams College, Graduate School, *Williamstown, Massachusetts* 01267 (NSG 5218)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0016, ANALYSIS AND INTERPRETATION OF PIONEER 10 AND 11 DATA
W.R. WEBBER, Univ. of New Hampshire, School of Technology, *Durham, New Hampshire* 03824 (NAS 5-24354)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0017, THEORY OF CRYSTAL GROWTH, ONE- AND TWO-DIMENSIONAL QUANTUM PHYSICS AND DEFECTS IN SOLIDS
S. CHUI, State University of New York, School of Arts & Sciences, *Albany, New York* 12222 (DMR76-11338 A01)

Several projects in theoretical solid-state physics will be carried out. (1) The theory of crystal growth will be studied, particularly the theory of the dynamics of crystal growth. (2) The theory of the renormalization group will be applied to the study of one-dimensional materials, especially the one-dimensional Hubbard model. The methods will also be extended to the two-dimensional Hubbard model. (3) Calculations will be carried out demonstrating the applicability of renormalization group ideas to quantitatively calculate defect states in solids.

This is a continuation of research previously supported under DMR-7611338.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0018, LASER AND OPTICAL PHYSICS 13410-P
M. LAX, City University of New York, School of Liberal Arts & Sci., *New York, New York* 10031 (DA0U5578; DAAG29 76 G0055)

To study (1) linear and nonlinear interaction of electromagnetic radiation with electric and magnetic polarization carrying excitations in condensed matter, (2) fluctuations in lasers and condensed matter including hydrodynamic instabilities, and (3) laser physics, including laser resonators, mode competition, light amplification. The use of interdependences between pyro, piezo, magneto, and electrooptic properties of materials forms the basis for a part of electronic device technologies. The laser work is relevant to the design of high-power lasers that are desired to operate in a single longitudinal mode to obtain a powerful, narrowly focused beam. The Bernard instability finds application in cloud formation in meteorology and the Rayleigh-Taylor instability is applicable to lubrication and flow over curved surfaces.

(1) A unifying Lagrangian approach is used, for both dissipative and non-dissipative phenomena, emphasizing rotational and displacement invariance in addition to usual (e.g., crystalline) symmetries. (2) Using efficient methods of calculating correlation functions for Fokker-Planck systems, study the onset of Bernard and Rayleigh-Taylor instabilities and the onset of turbulence in laminar flows induced by thermal gradients and shear forces. (3) Corrections to the paraxial approximation to the Maxwell equations are obtained and used to investigate the effects of refraction, gain saturation and diffraction in laser amplifiers.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

8.0019, THE PHYSICS OF SPIN-POLARIZED ATOMIC VAPORS
W. HAPPER, Columbia University, School of Arts & Sciences, *New York, New York* 10027 (DF038840; AF-AFOSR-2685-74)

AF function - the AF has a requirement for long-term, low-drift space reference systems. Opportunity - development of optically pumped frequency standards, magnetometers, and gyroscopes will benefit from study of magnetic resonance in dense vapors where spin exchange equilibrium prevails. Objective - investigation of the properties of high-density, optically pumped alkali vapors and development of ways to make use of these vapors in miniature, inexpensive devices like magnetometers and gyroscopes. Contribution - cheaper and more rugged navigation, guidance, and control devices.

This research is directed toward development of ways to optically pump a very dense alkali vapor with a laser. Advantages are: the high light flux from the laser will allow much more sensitive and rapid measurements of magnetic resonance frequencies than is feasible with conventional optically pumped systems or with conventional nuclear magnetic resonance or electron spin resonance techniques since gallium arsenide injection lasers are very small and potentially very inexpensive; a laser pumped magnetic resonance device can be very small and cheap compared to conventional devices; the active volume of a device operating in the high-density regime can be very much smaller than usual.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0020, SOLID-STATE MATERIALS DERIVED FROM PLANAR COMPLEXES

L.V. INTERRANTE, General Electric Company, *Schenectady, New York* 12305 (DF041500; F44620-76-C-0006)

AF function - future Air Force flight operations require improved electromagnetic devices for use in flight control, reconnaissance and surveillance, signal processing and control, and environmental support. Deficiency - a need exists for new materials which can be exploited for the design of new concepts and classes of electronic and magnetic devices. Objective - to obtain the understanding and predictive capability necessary for effective utilization of the unique features of existing transition metal complexes in solid-state applications and to permit purposeful synthesis of new materials for satisfying the requirements. How work contributes - new electromagnetic materials will be synthesized and their properties identified.

The research focuses on the synthesis of new solid-state materials, combining planar organic and transition metal complexes, and the characterization of their structures and physical properties.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0021, INTENSE RELATIVISTIC ELECTRON BEAM INVESTIGATIONS

W.O. DOGGETT, Univ. of North Carolina, School of Math. & Phys. Scis., *Raleigh, North Carolina* 27607 (DF044920; F49620-76-C-0007)

AF function - the AF has requirements for the development of weapons effects simulators, new microwave sources for advanced radars and electronic countermeasures, and advanced weapons concepts. Deficiency -no laboratory device can realistically simulate the radiation environment of a nuclear weapon. No conventional accelerator can maintain accelerating fields of megavolts per centimeter over many meters. Radar systems are not available which can locate and provide images of remote satellites in high orbits around the earth. Objective - the objectives of this work are (1) to characterize and enhance collective ion acceleration in vacuum diode geometries, (2) conduct an experimental investigation of the dielectric cathode guide phenomena to understand the basic mechanisms involved in the transport of relativistic electron beams, (3) experimentally determine the density and rotation rate profiles for a nonneutral electron beam propagating in an axial magnetic field in a conducting pipe, and (4) to develop techniques to focus relativistic electron beams into radii of the order of 0.1 mm. Contribution - the beam focusing and dielectric cathode transport studies are important for the development of pellet fusion X-ray sources. The collective ion acceleration work contributes to the development of advanced concepts.

The collective ion acceleration research will emphasize the luce vacuum diode geometry and is aimed at determining the mechanism involved in the acceleration. Experiments will be conducted on the low-impedance (7 Ohm) marx charged machine at NCSU and on the high-impedance (80 Ohm) Van de Graaf FX-75 at BREL. To characterize the dielectric guide cathode, optical techniques will be used to measure the breakdown velocity. These include fiber optic light pipes coupled to photomultiplier tubes and image converter camera pictures. A laser scattering technique will be used to measure the electron and ion density and the temperatures in the diode plasma. A q-switched ruby laser beam will be focused onto a small spot of diameter less than a millimeter and the scattered light will be collected and dispersed by a spectrometer into adjacent wavelength detection channels. The knowledge of these parameters in the diode plasma on a time-resolved basis should be useful in evaluating the collective ion acceleration mechanism. The combination of the laser scattering technique and the image converter camera will be used to measure the rotation rate. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0022, SUPERCONDUCTIVITY AND RADIATION-INDUCED DEFECTS IN A-15 COMPOUNDS

B.S. CHANDRASEKHAR, Case Western Reserve Univ., School of Science, *Cleveland, Ohio* 44106 (DMR77-09948)

A study of the anisotropy of the superconducting energy gap in high transition temperature A-15 superconductors will be undertaken to determine whether the anisotropy is an essential ingredient for the observed high Tc. A comprehensive set of measurements will be made on well-characterized single crystals of V3Si which have been subjected to various fluences of 50 MeV protons. Specific measurements such as the electrical resistivity, the elastic constants, the specific heat, the annealing and recovery times and the positron lifetimes will be made for the samples to determine the mean free path and anisotropy. Transmission electron microscopy will be used to study details of the defect structure. The program will provide data on the fundamental electronic and structural parameters of single crystals in the defect state. The immediate goal of the program is an improved understanding of the phenomenon of high-temperature superconductivity in the A-15 materials.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0023, A RESEARCH PROGRAM IN THEORETICAL HIGH-ENERGY PHYSICS

D. FELDMAN, Brown University, Graduate School, *Providence, Rhode Island* 02912 (EY-76-C-02-3130 TASK A)

During the coming year the major effort of the theoretical program will be devoted to studies of elementary particles and quantum field theory. Particular problems to be considered will include the analysis of high-energy reactions (single-particle and jet production and their correlations, gluon final states, quark scattering and confinement, hadron-hadron scattering, symmetry breaking in Reggeon field theory); properties of new particles; phenomenology of renormalizable gauge models; bound-state solutions (renormalization-group methods, unitarity restrictions); self-consistent solutions in field theory (four-Fermion interactions, mass splitting, two-dimensional models); generalization of the eikonal approximation; the anharmonic oscillator on a lattice; quantum field theory with local supersymmetry. It is also planned to devote some time to other problems of interest and importance in the theory of elementary particles as they may arise, as well as to certain aspects of general relativity, statistical mechanics, and the general theory of acoustics, applied to particle detection.

RESULTS: Last year's research program dealt with a variety of topics including hadron dynamics (Pomeron interaction in the eikonal approximation, estimates of all eikonal pionization graphs, study of the critical behavior in Reggeon field theory, status of Regge pole models in KN scattering); phenomenology of renormalizable gauge theory (tests of flavor mixing, dimuon events, SU(3) guage model with unmixed quarks, lepton models, CP violation, neutrino magnetic moment); spectral sum rules (axial-vector masses, mixing angles); application of the self-consistent field approximation to relativistic quantum field theory; topics in gravitation and cosmology; as well as other studies involving elementary particle interactions.

Part 1 of 2.

SUPPORTED BY U.S. Energy Research & Development Admin., Div. of High Energy & Nuclear Physics

8.0024, ELECTRONIC STATES AT SURFACES OF SOLIDS
L. KLEINMAN, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (DMR77-21559)

Theoretical calculations of the electronic structure of transition metal surfaces will be performed. First, ab initio calculations of the energy bands of a thin film of paramagnetic iron will be carried to self-consistency. Secondly, paramaterized LCAO calculations on thicker films will be done.

Also to be calculated is the photocurrent of each spin due to a single-step process involving the excitation of the electrons near the surface into time-reversed LEED states. The surface resonance in tungsten will be examined in order to settle the question of whether this experimental feature is due to a spin-orbit induced resonance or an ordinary surface state. Finally, using techniques developed for electron calculations, the phonon densities of states on stepped surfaces will be calculated.

Continuation of research supported by DMR73-02449 A02. This is the first year of a 3-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0025, TRIBO-EMISSION FROM OXIDE LAYERS ON METALS
P. BRAUNLICH, Washington State University, School of Arts & Sciences, *Pullman, Washington* 99163 (DF047170; F49620-77-C-0042)

AF function - future high-performance aircraft will employ an increasing amount of adhesively bonded structures. Deficiency - in order to obtain maximum strength, metal components are anodized to form a thin oxidized layer and the adhesive is then used to bond these layers together. The mechanical strength and other properties of the anodized oxide must be determined in order to insure compatibility and strength in the bonded region. Objective - the objective of this research is to examine the fracture dynamics and micromechanics of thin, anodized oxide films on metals by measuring the tribo-emission of charged particles during early stages of microcracking. How work contributes - analysis of the emitted particles will provide greater understanding and optimization of the oxide films grown on metals prior to adhesive bonding.

Tribo-emission of electrons, negative and positive ions and photons will be measured as a function of stress, strain, and fabrication variables. The micro imperfections, chemical and mechanical, will be characterized.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

SOCIAL SCIENCES

Includes Social Sciences (general); Administration and Management; Documentation and Information Science; Economics and Cost Analysis; Law and Political Science; and Urban Technology and Transportation.

9.0001, THE SOCIAL EFFECTS OF SATELLITE TELEVISION COMMUNICATION IN INDONESIA - PROGRAM CONTENT AND DETERMINANTS
G. CHU, Center for Cult. Tec. Interchg, *Honolulu, Hawaii* 96801 (INT77-15160)

This project provides partial support for the participation of investigators from the East-West Center and the Stanford Research Institute in one phase of a larger project to study the social effects of satellite television in Indonesia. Dr. Taufik Abdullah, director of the Indonesian National Institute of Economic and Social Research (LEKNAS), has approved the project and Dr. Alfian of LEKNAS will serve as co-principal investigator with Dr. Chu of the East-West Communication Institute. The objectives of this study are (1) documentation of the institutional constraints on the selection and production of television program content for rural development in Indonesia, and (2) analysis of the program content actually chosen. The project will collect data on policy goals of development-oriented television broadcasting, organizational capabilities for implementing the policy goals with respect to television broadcasting and software capabilities for television program production. A thematic analysis of television programs oriented for rural residents and general audiences will be conducted.

SUPPORTED BY U.S. National Science Foundation, Div. of International Programs

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, AEOLIAN GEOLOGY STUDIES
R. GREELEY, Arizona State University, Graduate School, *Tempe, Arizona* 85281 (NSG 2284)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0002, SPECTROSCOPIC STUDIES OF QUASISTELLAR OBJECTS
P.A. STRITTMATTER, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (AST77-23055)

A wide variety of projects have been investigated in order to understand the nature of the line-formation regions in quasistellar objects (QSO's). In the past years discoveries have been made that certain absortion systems with redshifts both greater and much less than the emission redshift must originate at distances so far from QSO's that the absorbing material cannot be directly associated with the quasar. In addition, the results of studies of absorption in low-redshift QSO's are consistent with the redshifts originating in intervening galaxies. Certain Seyfert galaxies and HII regions have been studied and interesting discoveries concerning the nature of the continuum radiation from the nucleus of the galaxy NGC 1068 and the hot star lambda Ori A were made.

The spectroscopic work on low-z QSO's will be continued for the next two years in order to find absorption systems that may arise in intervening galaxies which can be directly photographed in the red region of the spectrum and studied spectroscopically. Absorption systems in high-z quasars will also be observed at high resolution in order to determine element abundances and whether line-splitting is caused by radiation pressure ('line-locking'). Emission-line regions will be modeled theoretically in order to determine whether the line profiles can be accounted for in terms of radiation pressure. Finally, low-dispersion work on the identification of Molonglo sources will be continued, as well as the initiation of a new discovery program of radio-quiet high-redshift QSO's using a converging beam transmission grating. This is a continuation of grant AST 76-22991.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0003, BOLOMETERS FOR SPACE APPLICATIONS, TESTS OF GRID POLARIZERS
P.L. RICHARDS, Univ. of California, School of Letters & Science, *Berkeley, California* 94720 (NSG 2280)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0004, ULTRAVIOLET SPECTRA OF QUASARS, RELATED EXTRA-GALACTIC SOURCES, AND X-RAY SOURCES
M. BURBIDGE, Univ. of California, Graduate School, *San Diego, California* 92037 (NSG 7377)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0005, COMPUTED LYMAN-ALPHA AND BALMER-ALPHA SPECTRA FOR PUBLISHED CHROMOSPHERIC FLARE MODELS

R.C. CANFIELD, Univ. of California, Graduate School, *San Diego, California* 92037 (DF248770; F19628-77-C-0165)

AF function - communications, surveillance, detection, tracking. Deficiency - incomplete knowledge of the conditions in solar flares. Objective - to determine whether current solar flare models are based on realistic energy balances and what the quantitative characteristics of the flare energy-production mechanism are. How research contributes -provides a quantitative basis for computing the effects induced by solar flares.

Utilize existing Balmer and Lyman-alpha observations to compare with and modify computational models so that observed features of solar flare emission may be theoretically understood.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

10.0006, DYNAMICS OF GALAXIES BY THREE-DIMENSIONAL SIMULATIONS

R.H. MILLER, Univ. of Chicago, School of Physical Sciences, *Chicago, Illinois* 60637 (NCA 2-108801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0007, ELEMENTAL COMPOSITION AND ENERGY SPECTRA OF COSMIC-RAY NUCLEI

UNKNOWN, Univ. of Chicago, Graduate School, *Chicago, Illinois* 60637 (NAS 8-32828)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0008, EARTH ROTATION FROM LASER LUNAR DISTANCE RANGING

J.D. MULHOLLAND, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (DN675310; N00014-76-C-0641)

For reasons of navigation and accurate missile trajectory prediction, Navy requires an accurate knowledge of intercontinental distances, the position of the pole of rotation (true north) and the rate of the earth's rotation. This research will use data obtained from lunar laser-ranging experiments (in which distances to the moon are determined using laser beams returned from corner reflectors implanted on the moon by U. S. astronauts) to improve our knowledge of both intercontinental distances and earth rotational behavior, and to compare the desirability of this approach versus new competing techniques, i.e., long-baseline interferometry and satellite laser methods.

The contractor will emphasize two tasks: one, to determine the best distribution of observation stations to produce the most precise values of universal time and polar motion; and the second, to develop and apply computer techniques for reducing the data to yield universal time and polar motions precisely.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

10.0009, ATLAS OF THE ANDROMEDA GALAXY

P.W. HODGE, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105

An atlas of the Andromeda Galaxy, the nearest spiral galaxy to us, will be produced from a set of deep plates taken with the 4-meter telescope of the Kitt Peak National Observatory. The Atlas will provide identification of globular star clusters, open star clusters, HII regions, stellar associations, dust clouds, and variable stars and will be provided with a complete high-resolution photometric overlay grid of isophotes in blue light.

SUPPORTED BY National Geographic Society

GENERAL

11.0001, TO RIDE THE FRACTIOUS HORSE - THE AMERICAN AERONAUTICAL COMMUNITY AND THE PROBLEMS OF HEAVIER-THAN-AIR FLIGHT, 1875-1905

T.D. CROUCH, Smithsonian Institution, *Washington, District of Columbia* 20560

This volume is a study of the birth and evolution of a community of engineers in the United States interested in the problem of heavier-than-air flight prior to 1905. The study concentrates on the education, and interrelationships that bound members to this group as well as the institutional factors that functioned to create an effective community of technical contributors. The volume was awarded the AIAA History Manuscript prize for 1977 and is now being circulated to publishers.

SUPPORTED BY Smithsonian Institution, National Air & Space Museum

11.0002, FLIGHT RESEARCH AIRCRAFT OF THE POST-WAR ERA

R.P. HALLION, Smithsonian Institution, *Washington, District of Columbia* 20560

This investigation is intended to be an historical vehicle-by-vehicle study of postwar research aircraft. Each aircraft type will be examined with an in-depth critical analysis of its research function, accomplishments and contributions to aerospace research and development. Emphasis will be placed on American transonic, supersonic and hypersonic aircraft.

The research complements work on the Dryden Flight Research Center and is being conducted at a reduced level of activity until after completion of the Dryden History. Many of the records being reviewed on the Dryden History are pertinent to this research.

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N78-19047 Northwestern Univ., Evanston, Ill.
GENESIS N + 1: THE ORIGINS OF THE TURBO-JET REVOLUTION Ph.D. Thesis
Edward W. Constant, II 1977 554 p
Avail: Univ. Microfilms Order No. 77-32291

The derivation of radical airframe and gas turbine component performance assumptions from advances in theoretical aerodynamics was examined, in the invention of the turbo-jet engine. To facilitate comprehension of the complex elements and interrelations central to the turbo-jet revolution, an ideal typical model for technolgoical change similar to that of Thomas Kuhn's for science was proposed. In addition to portraying the direct impact of advances in scientific theory on technological change, the model also attempts to portray the relation of scientific method, especially the ideal of technological testability, to such change. Furthermore, the model describes the critical importance of technological systems interface constraints on changes in any one system or sub-system. Dissert. Abstr.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N78-19048*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF PERTURBED FLOW ON THE TRANSITION FROM THE SUPERSONIC LAMINAR BOUNDARY LAYER TO THE TURBULENT
A. M. Kharitonov Jan. 1978 18 p refs Transl. into ENGLISH from the book "Aeromekhanika" Moscow, Nauka Press, 1976 p 153-164 Original language document was A77-30570 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(NASA-TM-75196) Avail: NTIS HC A02/MF A01 CSCL 01A

Results of experimental studies on the effect of various factors on the transition of a supersonic boundary layer are discussed. It is shown that in supersonic wind tunnels, a significant effect on the transition of the boundary layer on a model is exerted by the scale of acoustic perturbations, which is proportional to the boundary layer displacement thickness of the working section. Experimental data obtained over a wide range of variation of flow parameters in aerodynamically similar test installations with different dimensions of the working section are generalized by means of a correlation parameter based on the displacement thickness. Author

N78-19049*# Boeing Commercial Airplane Co., Seattle, Wash.
TEST DATA REPORT, LOW SPEED WIND TUNNEL TESTS OF A FULL SCALE LIFT/CRUISE-FAN INLET, WITH ENGINE, AT HIGH ANGLES OF ATTACK
W. M. Shain Jan. 1978 165 p
(Contract NAS2-9640)
(NASA-CR-152055; T6-6145) Avail: NTIS HC A08/MF A01 CSCL 01A

A low speed wind tunnel test of a fixed lip inlet with engine, was performed. The inlet was close coupled to a Hamilton Standard 1.4 meter, variable pitch fan driven by a lycoming T55-L-11A engine. Tests were conducted with various combinations of inlet angle of attack freestream velocities, and fan airflows. Data were recorded to define the inlet airflow separation boundaries, performance characteristics, and fan blade stresses. The test model, installation, instrumentation, test, data reduction and final data are described. Author

N78-19050*# Burroughs Corp., Paoli, Pa.
NUMERICAL AERODYNAMIC SIMULATION FACILITY. PRELIMINARY STUDY EXTENSION. EXECUTIVE SUMMARY Final Report
Feb. 1978 11 p
(Contract NAS2-9456)
(NASA-CR-152106) Avail: NTIS HC A02/MF A01 CSCL 01A

An optimized functional design of key elements of the Numerical Aerodynamic Simulation Facility was investigated. The following tasks were performed and are discussed: (1) develop, optimize, and describe the functional description of the custom hardware; (2) delineate trade-off areas between performance, reliability, availability, serviceability, and programmability; (3) develop metrics and models for validation of the candidate system's performance; (4) conduct a functional simulation of the system design; (5) perform a reliability analysis of the system design; and (6) develop the software specifications to include a user level high level programming language, a correspondence between the programming language and instruction set, and outline the operating system requirements. Author

N78-19051*# Burroughs Corp., Paoli, Pa.
NUMERICAL AERODYNAMIC SIMULATION FACILITY. PRELIMINARY STUDY EXTENSION Final Report
Feb. 1978 273 p
(Contract NAS2-9456)
(NASA-CR-152107) Avail: NTIS HC A12/MF A01 CSCL 01A

The production of an optimized design of key elements of the candidate facility was the primary objective of this report. This was accomplished by effort in the following tasks: (1) to further develop, optimize and describe the function description of the custom hardware; (2) to delineate trade off areas between performance, reliability, availability, serviceability, and programmability; (3) to develop metrics and models for validation of the candidate systems performance; (4) to conduct a functional simulation of the system design; (5) to perform a reliability analysis of the system design; and (6) to develop the software specifications to include a user level high level programming language, a correspondence between the programming language and

instruction set and outline the operation system requirements.
Author

N78-19052*# Control Data Corp., St. Paul, Minn. Research and Advanced Design Lab.
PRELIMINARY STUDY FOR A NUMERICAL AERODYNAMIC SIMULATION FACILITY. PHASE 1: EXTENSION
N. R. Lincoln Feb. 1978 434 p refs
(Contract NAS2-9457)
(NASA-CR-152108) Avail: NTIS HC A19/MF A01 CSCL 01A

Functional requirements and preliminary design data were identified for use in the design of all system components and in the construction of a facility to perform aerodynamic simulation for airframe design. A skeleton structure of specifications for the flow model processor and monitor, the operating system, and the language and its compiler is presented. A.R.H.

N78-19053*# National Aeronautics and Space Administration, Washington, D. C.
TRANSONIC FLOW PAST AN AIRFOIL WITH CONDENSATION
B. Schmidt Mar. 1978 21 p refs Transl. into ENGLISH from Acta Mechanica (Austria), v. 2, 1966 p 194-208 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75201) Avail: NTIS HC A02/MF A01 CSCL 01A

In connection with investigations conducted to determine the influence of water vapor on experiments in wind tunnels, the question arose as to what changes due to vapor condensation might be expected in airfoil measurements. Density measurements on circular-arc airfoils aided by an interferometer in choked tunnels with parallel walls show that increasing humidity produces increasing changes in the flow field. The flow becomes nonstationary at high humidity. At the airfoil, however, the influence of the condensation is only felt, inasmuch as the shock bounding the local supersonic region moves upstream with increasing humidity while its intensity decreases. The density distribution upstream of the shock remains unchanged. Even if the flow becomes nonstationary in the vicinity of the airfoil, no changes occur at the airfoil. Author

N78-19054# National Aerospace Lab., Tokyo (Japan).
CALCULATION OF THE LIFT OF PARTIALLY-STALLED WINGS
Bradford H. Wick Apr. 1977 13 p refs
(NAL-TR-498T) Avail: NTIS HC A02/MF A01

Methods of calculating the lift and the spanwise distributions of the lift of thin sweptback wings with partially stalled flow were presented and evaluated. The evaluation was made by comparing the calculated and measured results for a number of wings. It was concluded that the methods provide a reasonably accurate means of calculating the lift and its spanwise distribution. Author

N78-19055*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
AN ANNULAR WING Patent Application
Harold J. Walker, inventor (to NASA) Filed 24 Feb. 1978 21 p
(NASA-Case-FRC-11007-1; US-Patent-Appl-SN-880725) Avail: NTIS HC A02/MF A01 CSCL 01A

An annular wing is described for the purpose of supporting an aircraft in flight without the use of directional stabilizer surfaces. The wing comprises an annular body of substantially uniform symmetrical configuration characterized by an annular positive lifting surface and a chord line. The wing is highly maneuverable, simple in concept, economic to fabricate and characterized by stable horizontal flight properties at subsonic speeds. NASA

N78-19056*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE ROLE OF TIME-HISTORY EFFECTS IN THE FORMULATION OF THE AERODYNAMICS OF AIRCRAFT DYNAMICS
Murray Tobak and Lewis B. Schiff Mar. 1978 12 p refs Proposed for Presentation at the AGARD Symp. on Dyn., Athens, Greece, 22-24 May 1978
(NASA-TM-78471; A-7328) Avail: NTIS HC A02/MF A01 CSCL 01A

The scope of any aerodynamic formulation proposing to embrace a range of possible maneuvers is shown to be determined principally by the extent to which the aerodynamic indicial response is allowed to depend on the past motion. Starting from the linearized formulation, in which the indicial response is independent of the past motion, two successively more comprehensive statements about the dependence on the past motion are assigned to the indicial response: (1) dependence only on the recent past and (2) dependence additionally on a characteristic feature of the distant past. The first enables the rational introduction of nonlinear effects and accommodates a description of the rate dependent aerodynamic phenomena characteristic of airfoils in low speed dynamic stall; the second permits a description of the double valued aerodynamic behavior characteristic of certain kinds of aircraft stall. An aerodynamic formulation based on the second statement, automatically embracing the first, may be sufficiently comprehensive to include a large part of the aircraft's possible maneuvers. The results suggest a favorable conclusion regarding the role of dynamic stability experiments in flight dynamics studies. Author

N78-19057*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE CHARACTERISTICS OF TWO ANNULAR DUMP DIFFUSERS USING SUCTION-STABILIZED VORTEX FLOW CONTROL
A. J. Juhasz and J. M. Smith 1978 14 p refs In ENGLISH; FRENCH summary Proposed for Presentation at the Joint Symp. on Design and Operation of Fluid Machinery, Fort Collins, Colo., 12-14 Jun. 1978
(NASA-TM-73857) Avail: NTIS HC A02/MF A01 CSCL 01A

Test results are described for two abrupt area change annular diffusers with provisions for maintaining suction stabilized toroidal vortices at the area discontinuity. Both diffusers had an overall area ratio of 4.0 with the prediffuser area ratio being 1.18 for diffuser A and 1.4 for diffuser B. Performance was evaluated at near atmospheric pressure and temperature for a range of inlet Mach numbers from 0.18 to 0.41 and suction rates from 0 to 18%. Static pressure recovery improved significantly as the suction rate was increased to approximately 11%. Results obtained with diffuser A were superior to that obtained with diffuser B. Flat radial profiles of exit velocity were not obtained since the flow showed preferential hub or tip attachment at moderate suction rates. At high suction rates the diffuser exit flow became circumferentially nonuniform and unstable. Author

N78-19058*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WATER-TUNNEL EXPERIMENTS ON AN OSCILLATING AIRFOIL AT RE EQUALS 21,000
Kenneth W. McAlister and Lawrence W. Carr Mar. 1978 84 p refs
(NASA-TM-78446; A-7232) Avail: NTIS HC A05/MF A01 CSCL 01A

Flow visualization experiments were performed in a water tunnel on a modified NACA 0012 airfoil undergoing large amplitude harmonic oscillations in pitch. Hydrogen bubbles were used to: (1) create a conveniently striated and well preserved set of inviscid flow markers; and (2) to expose the succession of events occurring within the viscous domain during the onset of dynamic stall. Unsteady effects were shown to have an important influence on the progression of flow reversal along the airfoil surface prior to stall. A region of reversed flow underlying a free shear layer was found to momentarily exist over the entire upper surface without any appreciable disturbance of the viscous-inviscid boundary. A flow protuberance was observed to develop near the leading edge, while minor vortices evolve from an expanding instability of the free shear layer over the rear portion of the airfoil. The complete breakdown of this shear layer culminates in the successive formation of two dominant vortices. Author

N78-19059*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMIC WIND-TUNNEL TESTS OF AN AEROMECHANICAL GUST-ALLEVIATION SYSTEM USING SEVERAL

DIFFERENT COMBINATIONS OF CONTROL SURFACES
Eric C. Stewart and Robert V. Doggett, Jr. Mar. 1978 37 p refs
(NASA-TM-78638; L-11918) Avail: NTIS HC A03/MF A01 CSCL 01A

Some experimental results are presented from wind tunnel studies of a dynamic model equipped with an aeromechanical gust alleviation system for reducing the normal acceleration response of light airplanes. The gust alleviation system consists of two auxiliary aerodynamic surfaces that deflect the wing flaps through mechanical linkages when a gust is encountered to maintain nearly constant airplane lift. The gust alleviation system was implemented on a 1/6-scale, rod mounted, free flying model that is geometrically and dynamically representative of small, four place, high wing, single engine, light airplanes. The effects of flaps with different spans, two size of auxiliary aerodynamic surfaces, plain and double hinged flaps, and a flap elevator interconnection were studied. The model test results are presented in terms of predicted root mean square response of the full scale airplane to atmospheric turbulence. The results show that the gust alleviation system reduces the root mean square normal acceleration response by 30 percent in comparison with the response in the flaps locked condition. Small reductions in pitch-rate response were also obtained. It is believed that substantially larger reductions in normal acceleration can be achieved by reducing the rather high levels of mechanical friction which were extant in the alleviation system of the present model. Author

N78-19060# Illinois Inst. of Tech., Chicago.
VORTICITY MEASUREMENTS USING CALIBRATED VANE-VORTICITY INDICATORS AND COMPARISON WITH X-WIRE DATA
R. A. Wigeland, H. M. Nagib, and M. Ahmed 1977 9 p refs Presented at the 10th AIAA Fluid and Plasma-Dyn. Conf., Albuquerque, N. Mex., 27-29 Jun. 1977 Prepared in cooperation with Abbott Labs., North Chicago, Ill.
(Grant DAHC04-74-G-0160)
(AD-A048451; ARO-12290.5-E) Avail: NTIS HC A02/MF A01 CSCL 20/4

Vane-type vorticity indicators of various sizes have been constructed, calibrated and used for direct and rapid measurement of local mean streamwise vorticity in several swirling flows. The dependence of their calibration factor, which relates the van rotational speed to the local angular velocity of the fluid, on the free-stream velocity, the fluid rotational speed, and the transverse vorticity gradient was determined. When the vanes were carefully calibrated, and regularly checked and maintained, good agreement was achieved between vorticity profiles obtained using them and X-wire data. Otherwise, a vane can only be used to give an indication of vorticity. Author (GRA)

N78-19061# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.
A LIFTING SURFACE THEORY FOR WINGS EXPERIENCING LEADING-EDGE SEPARATION Final Report, 1 Jan. 1975 - 30 Jun. 1977
Thomas K. Matoi and Sheila E. Widnall 30 Jun. 1977 148 p refs
(Contract N00014-75-C-0257)
(AD-A048439; ONR-CR215-230-3F) Avail: NTIS HC A07/MF A01 CSCL 20/4

This report describes a nonlinear lifting surface theory for a wing with leading-edge vortices in a steady, incompressible flow. A numerical scheme has been developed from this theory and initial runs have been made for the delta wing and arrow wing planforms. A general procedure for other planforms is also described. The present formulation is the result of an extensive modification of the work of Nangia and Hancock, in which a model of the leading-edge vortex is added to a vorticity representation of the wing and wake. This lifting surface theory program is based on the kernel function formulation, in that the vorticity distribution is described by continuous functions with unknown coefficients. The vortex location is similarly described by functions with unknown coefficients. These unknowns are found by satisfying the downwash condition and the no-force condition on the leading-edge vortex representation. Due to the nonlinear nature of the boundary conditions with respect to the vortex position, the solution is obtained from an iterative scheme based on Newton's method. Results for the delta wing and arrow wing are presented and compared with experiment and other theories. GRA

N78-19062# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN EXPERIMENTAL INVESTIGATION OF STEADY ASYMMETRIC VORTEX SHEDDING FROM A SLENDER BODY OF REVOLUTION AT HIGH ANGLES OF ATTACK M.S. Thesis
Robert Rudolph Turelli Dec. 1977 64 p refs
(AF Proj. 1366)
(AD-A048370; AFIT/GAE/AA/77D-15) Avail: NTIS HC A04/MF A01 CSCL 21/4

An experimental investigation of the effects of Mach number and Reynolds number on the side forces induced on a slender body of revolution at high angles of attack was conducted. The tests were carried out in the Air Force Flight Dynamics Laboratory's Trisonic Gasdynamic Facility. GRA

N78-19063# Army Missile Research and Development Command, Redstone Arsenal, Ala. Aeroballistics Directorate.
THEORETICAL ANALYSIS OF THE FLOW FIELD OVER A FAMILY OF OGIVE BODIES
Ronnie W. Guy 16 Aug. 1977 458 p
(DA Proj. 1L3-62303-A-214)
(AD-A048477; DRDMI-TD-CR-77-5) Avail: NTIS HC A20/MF A01 CSCL 20/4

Several analytical methods were employed to calculate the flow fields about spherically blunted ogives from Mach numbers of zero to 4.5. The methods used were the Dougles Herman (a panel method) with compressibility correction, the South potential flow program (RAXBOD) and the three dimensional method of characteristics. Bluntnesses varied from zero (sharp nosed) to one (hemispherical nose) and the finess ratio varied from 0.5 to 4.0. Where the computer codes being used permitted, the flow fields were calculated for 2 deg and 0 deg angle of attack; in all other cases only 0 deg angle of attack was considered. Data are presented for body surface distributions of pressure and Mach number and for wave drag. Author (GRA)

N78-19064# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
LINEARIZED NEWTONIAN AERODYNAMICS OF SLENDER INFLATED CONES Interim Report
John W. Ellinwood 5 Dec. 1977 37 p
(Contract F04701-77-C-0078)
(AD-A048695; TR-0078(3940-02)-1; SAMSO-TR-77-218)
Avail: NTIS HC A03/MF A01 CSCL 16/3

Bionic vehicles covered with unsupported cloth are predicted to experience skin displacement from aerodynamic pressure at small angle of attack. The resulting shape, aerodynamic force, and moment perturbations are predicted as functions of given axial tension and internal pressurization. A tension parameter is identified that varies inversely as dynamic pressure. It is concluded that the inflatable loses its shape dramatically unless this tension parameter is least of order one, and that this useful boundary cannot be appreciably extended by increasing pressurization, unless the internal pressure is at least an order of magnitude larger than external pressures. Author (GRA)

N78-19065# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
AERODYNAMIC COMPUTER CODE FOR COMPUTING PRESSURE LOADING ON COMPLETE MISSILE FOR STRUCTURAL ANALYSIS Final Report, 1 Jun. 1976 - 31 Dec. 1977
Kenneth K. Wang Jan. 1978 215 p refs
(AD-A048840; MDC-G7215) Avail: NTIS MF A01 CSCL 01/1

Aerodynamic computer code for calculating the pressure distribution on missile or its components e.g., body and wings and to interpolate by surface fit at locations as specified for structural analysis using the NASTRAN computer code.
Author (GRA)

N78-19066# Purdue Univ., Lafayette, Ind. Project SQUID Headquarters.
MECHANISMS OF DECAY OF LAMINAR AND TURBULENT VORTICES
Mahinder Uberoi (Colorado Univ., Boulder) Dec. 1977 31 p refs
(Contract N00014-75-C-1143; Proj. SQUID)
(AD-A049176; SQUID-UC-L-PU) Avail: NTIS HC A03/MF A01 CSCL 20/4

Dynamics of an infinitely long one-dimensional vortex and a swirl are compared with dynamics of a semi-infinitely long trailing vortex and trailing swirl. With increasing distance, the change in axial velocity difference between the core of the trailing-vortex and the surrounding region causes radial convection and some associated axial convection of angular momentum. In laminar or turbulent trailing vortices, this is the dominant mechanism for decrease in velocities of swirl in the core and corresponding growth of the core. Axial velocity difference between the core of the trailing-vortex and the surrounding region is necessary for the sustenance of turbulence in the vortex core. A theory of turbulent trailing-vortex is developed on the basis of these mechanisms and the results are compared with experimental observations. Author (GRA)

N78-19067# Beech Aircraft Corp., Wichita, Kans.
GUIDED DROGUE FLIGHT TEST REPORT Final Report, Nov. 1976 - Nov. 1977
J. A. Ellsworth, W. R. Fox, D. E. Lovendahl, and J. E. Moore 6 Sep. 1977 43 p refs
(Contract N00019-76-C-0555)
(AD-A049164; E-23027) Avail: NTIS HC A03/MF A01 CSCL 01/2

An experimental maneuverable aerial refueling drogue was designed, fabricated, and flight tested. The drogue was trailed from the wing tip of a CC-137 tanker. Tests were conducted from 200 to 300 KEAS. The drogue exhibited stable trail, and maneuvering commands resulted in drogue displacements similar to predictions. Author (GRA)

N78-19068# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.
UNSTEADY TRANSONIC FLOW COMPUTATIONS
A. R. Seebass Sep. 1977 35 p refs Presented at the AGARD Fluid Dyn. Panel Symp. on Unsteady Aerodynamics, Ottawa, 26-28 Sep. 1977
(Contract N00014-76-C-0182)
(AD-A049188) Avail: NTIS HC A03/MF A01 CSCL 20/4

The effects of unsteady modes of motion on two-dimensional transonic flows are investigated. Numerical algorithms that treat shock waves as moving discontinuities are described for nonlinear and time-linearized perturbation flows. Results for transonic flow past an NACA 64A006 airfoil experiencing harmonic motions in one of several modes are presented. Author (GRA)

N78-19069# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN AERODYNAMIC INVESTIGATION OF A FORWARD SWEPT WING M.S. Thesis
Kenneth Lewis Sims Dec. 1977 115 p refs
(AD-A048898; AFIT/GAE/AA/77D-14) Avail: NTIS HC A06/MF A01 CSCL 20/4

This study consisted of modeling and wind tunnel testing of a high speed, subsonic, low aspect ratio, forward swept wing with an advanced supercritical airfoil section for the purpose of determining its lift, drag, and pitching moment characteristics as compared to a similar aft swept wing. Tests were conducted at Mach numbers of 0.63 to 0.93 in the Air Force Flight Dynamics Laboratory's Trisonic Gasdynamic Facility located at Wright-Patterson Air Force Base, Ohio. Two wing configurations, forward and aft swept, were tested and compared to computer predictions provided by the Unified Subsonic-Supersonic Program (Woodward's Version B). The results indicated that the forward swept wing was capable of higher useable angles of attack while maintaining a lower drag coefficient for angles of attack below eight degrees. Wind tunnel test results are presented in graphical and tabular form for use in future design studies of similar aerodynamic configurations. Author (GRA)

N78-19070# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DOUBLET LATTICE AERODYNAMIC PREDICTIONS FOR AN OSCILLATING F-5 WING WITH STORES M.S. Thesis
Daniel L. Parker Dec. 1977 99 p refs
(AD-A048968; AFIT/GAE/AA/77D-10) Avail: NTIS HC A05/MF A01 CSCL 20/4

The Doublet Lattice Method with the Method of Images was used to predict Unsteady Aerodynamic Coefficients and Pressures on a Model F-5 Wing with various store configurations, oscillating in subsonic flow. Various finite element lattice configurations were tested to obtain numerical convergence and indicate the optimum modelling technique. Test conditions included Mach numbers of .6, .8, .9 and .95. At each Mach number, oscillation frequencies of 0, 20 Hz, and 45 Hz were considered. Convergence studies confirmed the utility and accuracy of Multhopp or sinusoidal lattice distributions. Steady state pressure predictions compared favorably to those obtained by Woodward's Method. Predictions showed significant increases in aerodynamic forces caused by adding tip stores to the wing. Author (GRA)

N78-19071# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MAGNUS EFFECTS ON BALLISTIC TRAJECTORIES M.S. Thesis
James D. Schneider Dec. 1977 118 p refs
(AD-A048966; AFIT/GA/AA/77D-8) Avail: NTIS HC A06/MF A01 CSCL 19/4

The effect of Magnus coefficients, projectile spin rate, and pitching motion on lateral displacement of a ballistic trajectory is investigated by use of a six degree of freedom simulation. The coefficients had no significant effect. Increased spin rate extends the projectile impact point both down range and cross range. Oscillations induced by rate motion increased the lateral deviation but oscillations induced by an initial displacement did not. Author (GRA)

N78-19072# Martin Marietta Corp., Baltimore, Md.
BOUNDARY LAYER OVER SPINNING BLUNT-BODY OF REVOLUTION AT INCIDENCE INCLUDING MAGNUS FORCES
K. C. Wang 1977 56 p refs
(Contract F49620-76-C-0004)
(AD-A049199; AFOSR-77-1306TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

An incompressible laminar flow over a spinning blunt-body at incidence is investigated. The approach follows strictly the three-dimensional boundary layer theory, and the lack of initial profiles is readily resolved. The rule of the dependence zone is satisfied with the Krause scheme and complete numerical solutions are obtained for an ellipsoid of revolution at 6 deg incidences and two different spin rates. Spinning causes asymmetry which, in turn, introduces the Magnus force. The asymmetry is most pronounced in crossflow, but is also noticeable in the skin-friction and displacement thickness of the meridional flow. A variety of crossflow profiles are determined as are the streamline patterns in the cross- and meridional-planes which are especially useful in visualizing the flow structure. Detailed distribution of skin frictions, displacement thicknesses, and centrifugal pressure are presented. A new derivation of the total displacement thickness is given and a negative displacement thickness is found physically meaningful. The Magnus forces due to the crossflow skin friction and the centrifugal pressure are determined; these two forces partly compensate each other. At lower spin rate, the frictional force is larger, resulting in a positive Magnus force. At high spin rate, the opposite is obtained. At high incidence (30 deg), the leeside separated region associated with an open separation is found not amenable to a classical boundary layer treatment. The present boundary layer calculations could be carried out, in the longitudinal direction, only up to the beginning of an open separation. Since an open separation moves forward with increasing incidence, the calculable area, therefore, decreases. Author (GRA)

N78-19073# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
LIFT HYSTERESIS OF AN OSCILLATING SLENDER ELLIPSE Interim Report

W. Donald Jonnson and J. C. Williams, III 30 Sep. 1977 45 p refs
(Grants DAHC04-75-G-0007; DA-ARO(D)-31-124-72-G134) (AD-A049343; ARO-10157.7-E) Avail: NTIS HC A03/MF A01 CSCL 20/4

A theoretical investigation has been made to determine the variation of lift with time on a slender elliptic cylinder oscillating in pitch. The development of the unsteady two-dimensional laminar boundary layer over the surfaces of the pitching ellipse is calculated and the periodic variation of lift is determined by matching the rate at which boundary layer developed vorticity is shed into the wake with the time rate of change of circulation about the ellipse. The effects of mean angle-of-attack and oscillation frequencies on lift hysteresis loops are determined. It is shown that the hysteresis loops change direction for mean angles of attack greater than that corresponding to maximum steady state lift. Author (GRA)

N78-19074# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATIC STABILITY OF VEHICLES WHICH USE THE LIFTING FORCE OF AIRFOILS
V. I. Koroley 27 Jul. 1977 20 p ref Transl. into ENGLISH from Sudostr. i Morskiye Sooruzheniya (USSR), no. 2, 1966 p 45-55
(AD-A049069; FTD-ID(RS)T-1239-77) Avail: NTIS HC A02/MF A01 CSCL 20/4

In designing rapid transportation facilities which use the lifting force of airfoils near a solid or liquid screen, one important problem is that of providing stable motion of sufficient duration. In the present article we discuss the problem of static stability in vehicles which have two airfoils - a leading and a trailing (tandem system) - separated by a certain distance, determined by the length of the cabin body. GRA

N78-19075# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE HOVERING AND FORWARD FLIGHT CHARACTERISTICS OF THE AEROCRANE HYBRID HEAVY LIFT VEHICLE Final Report
W. F. Putman and H. C. Curtiss, Jr. Sep. 1977 135 p refs (Contract N62269-76-C-0464)
(AD-A049084; AMS-TR-1351; NADC-76201-30) Avail: NTIS HC A07/MF A01 CSCL 01/3

Results of an analytical and experimental investigation of an AEROCRANE hybrid heavy lift vehicle are discussed. The experimental program involved free-flight investigations of the trim and dynamic stability characteristics of the AEROCRANE in hovering and forward flight using a Froude-scaled model. The effects of a simple feedback system on the dynamic stability of the model and the ability of a remote pilot to control the model are discussed. Analytical predictions of the model characteristics showed very good agreement with the experimental data. Author (GRA)

N78-19076# Naval Postgraduate School, Monterey, Calif.
LASTOP: A COMPUTER CODE FOR LASER TURRETS OPTIMIZATION OF SMALL PERTURBATION TURRETS IN SUBSONIC OR SUPERSONIC FLOW Final Report, 1976 - 1977
Garret N. Vanderplaats and Allen E. Fuhs 20 Dec. 1977 240 p refs
(AD-A049272; NPS-69-77-004) Avail: NTIS MF A01 CSCL 01/1

A program has been developed which calculates optical path length and phase distortion arising from the density field surrounding a laser turret. Further, the program finds the optimum turret shape yielding minimum phase distortion. The aerodynamic model is briefly described; however, the optimization and control codes are thoroughly presented. Sample data input and sample output are given. The program is listed. The material is presented in detail so that this report constitutes a user's manual. Author (GRA)

N78-19077# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A WING IN AN UNSTEADY GAS FLOW, PART 1
S. M. Belotserkovskiy, B. K. Skripach, and V. G. Tabachnikov 8 Sep. 1977 517 p Transl. into ENGLISH of the book "Krylo v Nestatsionarnom Potoke Gaza" Moscow, Izd. Nauka 1971 p 1-767 3 Vol.
(AD-A048999; FTD-ID(RS)T-1543-77-Pt-1) Avail: NTIS HC A22/MF A01 CSCL 01/3

Contents: Aerodynamic Coefficients; Formulation of the Problem of the Unsteady Motion of Wing; Basic Formula for the Potential of the Disturbed Velocities; Common Properties of Linear Unsteady Problems, and Similarity Parameters; Duhamel Integral, Theorem of Momentum, and Rational Method of Solution of Linear Unsteady Problems; Reciprocity Theorem and Its Corollaries; Experimental Determination of Unsteady Aerodynamic Wing Characteristics; Low Speeds (Incompressible Medium M = 0); The Velocity Field of Oblique Horseshoe Vortex in an Incompressible Medium; Method of the Calculation of Aerodynamic Wing Characteristics with the Harmonic Dependences of the Kinematic Parameters on Time; and Method of the Calculation of Aerodynamic Wing Characteristics with the Arbitrary Dependences of the Kinematic Parameters on Time. GRA

N78-19078# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.,
A WING IN AN UNSTEADY GAS FLOW, PART 2
S. M. Belotserkovskiy, B. K. Skripach, and V. G. Tabachnikov 8 Sep. 1977 497 p Transl. into ENGLISH of the book "Krylo v Nestatsionarnom Potoke Gaza" Moscow, Izd., Nauka 1971 p 1-767 3 Vol.
(AD-A049000; FTD-ID(RS)T-1534-77-Pt-2) Avail: NTIS HC A21/MF A01 CSCL 01/3

Contents: Method of the Calculation of Apparent Additional Masses of Wings of Arbitrary Planform; Some Point Solutions; Calculation of the Unsteady Wing Characteristics of Arbitrary Planform; High Subsonic Speeds (0 - M - 1); Method of the Calculation of the Coefficients of Aerodynamic Derivatives; The Velocity Field of Unsteady Discrete Vortex in a Compresses Medium; Method of the Calculation of Aerodynamic Wing Characteristics with Arbitrary Time Dependences; Some Known Solutions; Calculation of the Unsteady Wing Characteristics of Arbitrary Planform; Supersonic Speeds (M = 2); Numerical Method of the Calculation of Aerodynamic Wing Characteristics with Harmonic Time Disturbances; Numerical Method of the Calculation of Aerodynamic Wing Characteristics with Arbitrary Time Dependences; and Some Exact Solutions for Wings with Supersonic Edges with Harmonic Time Dependences. GRA

N78-19079# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A WING IN AN UNSTEADY GAS FLOW, PART 3
S. M. Belotserkovskiy, B. K. Skripach, and V. G. Tabachnikov 8 Sep. 1977 384 p refs Transl. into ENGLISH of the book "Krylo v Nestatsionarnom Potoke Gaza" Moscow, Izd., Nauka 1971 p 1-767 3 Vol.
(AD-A049001; FTD-ID(RS)T-1543-77-Pt-3) Avail: NTIS HC A17/MF A01 CSCL 01/3

Contents: Some Precise Solutions for Wings with Supersonic Edges with Arbitrary Time Dependences; Procedure of Calculation of the Aerodynamic Wing Characteristics of Arbitrary Planform; Practical Applications; Special Features of the Practical Use of Duhamel Integral in Tasks of Aerodynamics; Approximation Method; Coefficients of the Aerodynamic Derivative and of Apparent Additional Masses; Some Common Properties of Unsteady Effect of Planform, Numbers M and p^* on the Aerodynamic Derivatives of Wings; and Effect of Planform, the Mach Numbers and Laws of Motion for Transient Functions. GRA

N78-19080# Hebrew Univ., Jerusalem (Israel).
THE DYNAMICS OF NON SPHERICAL PARTICLES Final Technical Report, 1 Mar. 1975 - 1 Jun. 1977
Isaiah Gallily Jun. 1977 75 p refs
(Grant DA-ERO-75-G-021; DA Proj. 2M0-6110-B-53B) (AD-A047144) Avail: NTIS HC A04/MF A01 CSCL 04/1

In this paper the aerodynamic translational mobility of nonspherical was experimentally determined for Knudsen numbers of up to 0.2. The particles were glass cylinders, which represent asbestos fibers and ice needles, and cubes, which

represent the primary constituents of metal oxide aggregates. The method of determination and the apparatus used were based on a stereophotography of the trajectories of the particles in still air and a photogrammetric measurement of the (three) dimensions of the particles in a scanning electron microscope. The results for cylinders, compared with continuous fluid theoretical values of the coefficients, show a reasonable correspondence with expectation which even improved when the blunt edge effect of the particles was taken into consideration. However, in the case of cylinders having diameters above 1 micrometer, the experimentally determined coefficients were higher by about 50% than the continuous fluid calculated ones, whereas in the case of cylinders of diameters less than 0.5 micrometers, the determined coefficients were smaller than the calculated values. The resistance coefficients of cubes showed similar tendencies. The deposition of cylindrical particles in still air was studied in a specially constructed sedimentation cell; in this cell, a method for the size distribution analysis of these particles was tried. GRA

N78-19779*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTATIONAL AERODYNAMICS AND THE NUMERICAL AERODYNAMIC SIMULATION FACILITY
Victor L. Peterson *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 5-30 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19791*# McDonnell-Douglas Research Labs., St. Louis, Mo.
VISCOUS FLOW SIMULATIONS IN VTOL AERODYNAMICS
W. W. Bower *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 154-167 refs (For availability see N78-19778 10-59)
(Contract N00014-76-C-0494)
Avail: NTIS HC A22/MF A01 CSCL 01A

N78-19795*# Georgia Inst. of Tech., Atlanta.
PROSPECTS FOR COMPUTATIONAL AERODYNAMICS
J. C. Wu *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 221-227 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 01A

N78-19797*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MODELING OF THE REYNOLDS STRESSES
Morris W. Rubesin *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 239-247 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N78-19081# Transportation Research Board, Washington, D. C.
IMPLEMENTATION PLAN FOR AN AIR TRANSPORTATION RESEARCH INFORMATION SERVICE Final Report
Sep. 1977 137 p
(Contract DOT-FA77WA-3872)
(AD-A049301; FAA-EM-77-14) Avail: NTIS HC A07/MF A01 CSCL 01/2

An air transportation research information service (ATRIS) that would provide the user community with abstracts of documents and resumes of research projects that relate to the air transport field was presented. The potential user community for ATRIS services and products was discussed; recommendations were made for specific types of interactions between ATRIS and the user community. Input scope was presented in terms of twenty one subject areas and sixteen types of information. Output scope was presented in terms of announcement bulletins, special bibliographies, and batch mode and on line retrieval services. The report includes an implementation plan for the first three years of ATRIS development and operations. The plan contains specific proposals for input/output operations in each year, cost estimates for the proposed operations, and funding strategies for meeting the cost requirements through support from sponsors, institutional supports, and user charges. Author

N78-19082*# Washington Univ., St. Louis, Mo. Dept. of Civil Engineering.
BENEFIT-COST EVALUATION OF AN INTRA-REGIONAL AIR SERVICE IN THE BAY AREA Technical Report, 1 Jan. - 31 Dec. 1977
Lonnie E. Haefner 28 Dec. 1977 285 p refs
(Grant NsG-2170)
(NASA-CR-152084) Avail: NTIS HC A13/MF A01 CSCL 05C 05C

Utilization of an iterative statistical model is presented to evaluate combinations of commuter airport sites and surface transportation facilities in confunction with service by a given commuter aircraft type in light of Bay Area regional growth alternatives and peak and off-peak regional travel patterns. The model evaluates such transportation options with respect to criteria of airline profitability, public acceptance, and public and private nonuser costs. It incorporates information modal split, peak and off-peak use of the air commuter fleet, terminal and airport cost, development costs and uses of land in proximity to the airport sites, regional population shifts, and induced zonal shifts in travel demand. The model is multimodal in its analytical capability, and performs exhaustive sensitivity analysis. Author

N78-19083# Wyle Labs., Inc., Huntsville, Ala.
AN EVALUATION OF PERFORMANCE AND EFFECTIVENESS OF A MAN OVERBOARD DETECTION AND LOCATION SYSTEM
J. Bowman, R. Douglas, R. Giuntini, D. Lunn, and E. Sager Sep. 1977 78 p
(Contract DOT-CG-40672-A)
(AD-A049051; MSR-77-62; USCG-D-71-77) Avail: NTIS HC A05/MF A01 CSCL 06/7

This project deals with development of a man overboard detection and location system for use on documented vessels. Preliminary research indicated that radio (RF) systems offered more potential than sonar. The concept for use of the RF system involves a small transmitter the size of a metal tape rule to be worn by each crewman while on deck. In the event of a fall overboard, the unit automatically begins transmitting which actuates an alarm and serves as a homing device for rescue. The major part of this effort was the demonstration of successful reception of an RF signal from a small prototype man overboard type of transmitter located at varying depths in fresh and salt water. Range for fresh water tests was greater than one mile. Range for salt water was considerably less. A program for development of an operational man overboard system for Great Lakes, inland waters/rivers, and deep sea vessels is discussed. Author (GRA)

N78-19084# Boeing Vertol Co., Philadelphia, Pa.
CRASHWORTHY TROOP SEAT TESTING PROGRAM Final Report, May 1974 - Dec. 1976
M. J. Reilly Nov. 1977 206 p refs
(Contract DAAJ02-74-C-0036; DA Proj. 1L2-62209-AH-76)
(AD-A048975; D210-11169-1; USAAMRDL-TR-77-13) Avail: NTIS HC A10/MF A01 CSCL 01/3

Crashworthy troop seat designs developed under a previous contract were reviewed and design refinements were made. Component testing was planned and tests were performed. Malfunctioning components were redesigned and were retested satisfactorily. A new tubular-strut energy attenuator was developed to replace the rolling helical-wire energy attenuator which did not function properly. Crashworthy troop seats fabricated under a previous contract were modified, with new components developed during component testing. Additional seats were fabricated for static testing in various crash impact attitudes. A

total of six static tests, including two retests required as a result of minor failures, were performed by Dynamic Science as a subcontractor. Analysis of the test results showed that the forward- and aft-facing seat configurations were highly successful in meeting the test objectives in all attitudes, with the exception of the lateral loading. Eleven dynamic tests were performed by FAA-Civil Aeromedical Institute in three series of tests. GRA

N78-19085# Naval Ship Research and Development Center, Bethesda, Md.

NAVAL EMERGENCY AIR CARGO DELIVERY SYSTEM (NEACDS) FEASIBILITY TESTS AND EVALUATION Final Report, Oct. 1973 - May 1977

Russell H. Putnam, Maurice J. Zubkoff, Fred A. Myers, and Thomas E. Wheatley Dec. 1977 94 p refs

(AD-A048988; DTNSRDC-77-0117) Avail: NTIS HC A05/MF A01 CSCL 01/3

The Naval Emergency Air Cargo Delivery System (NEACDS) is designed to provide an emergency delivery capability to resupply priority items to ships at sea from fixed wing aircraft via airdrop. The major objective of the project has been to establish the feasibility of this concept with the added provisions of (1) not putting a man or boat in the water during retrieval up through sea state 4, and (2) using commonly available off-the-shelf materials. The basic naval problems solved were waterproofing, shock mitigation, load flotation, and retrieval at sea. Coordinating procedures for ship-aircraft operations and communications were developed. The feasibility of NEACDS has been demonstrated and a limited capability is available for use. This report summarizes the program of static drops, range airdrops and fleet drops for the NEACDS. GRA

N78-19086# National Transportation Safety Board, Washington, D. C. Bureau of Accident Investigation.

AIRCRAFT ACCIDENT REPORT: KNOB HILL, INC., CESSNA-421, N999MB, NOGALES, ARIZONA, 22 JANUARY 1977

27 Oct. 1977 33 p

(NTISUB/C/104-011; NTSB-AAR-77-11) Avail: NTIS HC A03/MF A01; Paper copy also available on subscription, North American Continent price $35.00/year; all others write for quote CSCL 01B

Radar contact with the aircraft was acquired north of Nogales at 9,000 ft. The controller advised the pilot to turn immediately because of a mountain peak, but radar contact was lost. The aircraft was destroyed and both occupants were killed. The National Transportation Safety Board determines that the probable cause of the accident was the controllers' issuance of an improper departure clearance, climb restriction, and altitude clearance. The controllers' lack of knowledge and noncompliance with standard ATC procedures placed the aircraft in proximity to high terrain. GRA

N78-19087# National Transportation Safety Board, Washington, D. C. Bureau of Accident Investigation.

AIRCRAFT ACCIDENT REPORT: TEXAS INTERNATIONAL AIRLINES, INC., DOUGLAS DC-9-14, N9104, STAPLETON INTERNATIONAL AIRPORT, DENVER, COLORADO, 16 NOVEMBER 1976

27 Oct. 1977 50 p

(NTISUB/C/104-010; NTSB-AAR-77-10) Avail: NTIS HC A03/MF A01; Paper copy also available on subscription, North American Continent price $35.00/year; all others write for quote CSCL 01B

On November 16, 1976, a McDonnell Douglas DC-9-14, crashed after rejecting a takeoff from runway 8 right at Stapleton International Airport, Denver, Colorado. The takeoff was rejected when the stall warning stick shaker activated after the aircraft had rotated for takeoff. The aircraft overran the runway, traversed drainage ditches, struck approach light stanchions, and stopped. Eighty-one passengers and five crewmembers evacuated the aircraft, 14 persons were injured. The National Transportation Safety Board determines that the probable cause of this accident was a malfunction of the stall warning system for undetermined reasons which resulted in a false stall warning and an unsuccessful attempt to reject the takeoff after the aircraft had accelerated beyond refusal and rotation speeds. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

N78-19088# National Aviation Facilities Experimental Center, Atlantic City, N. J.

HIGH-ALTITUDE AREA NAVIGATION (RNAV) ENROUTE SIMULATION Final Report, Mar. - Aug. 1976

Francis M. Willett, Jr. and Mark R. Taylor Dec. 1977 85 p refs

(FAA Proj. 044-326-080)

(AD-A049315; FAA-NA-77-4; FAA-RD-77-128) Avail: NTIS HC A05/MF A01 CSCL 17/7

A four-part dynamic simulation using two systems of navigation, area navigation (RNAV) and very high frequency omnidirectional radio range (VOR), was conducted to: (1) validate the results derived from fast-time simulation tests of RNAV and Jet-VOR route structures through real-time simulation tests; (2) determine whether benefits resulted from the application of RNAV in the high-altitude enroute environment; and (3) establish the impact that the number of potential aircraft conflict situations has on the ATC system and system user. Simulations were conducted in a fast-time mode, without controller intervention, for an area encompassed by five high altitude Chicago Air Route Traffic Control Center sectors and for a single selected sector of the five. Real-time simulations, with controller intervention, were conducted for both the five- and one-sector configurations. Test results showed a significant reduction in controller workload in the RNAV system compared to the VOR system for both sector configurations. Comparison of the fast-time potential conflict data with real-time controller workload and system performance measures did not show any correlation between the two sets of data. Author

N78-19089# National Aviation Facilities Experimental Center, Atlantic City, N. J.

DERIVATION OF GROUNDSPEED INFORMATION FROM AIRBORNE DISTANCE MEASURING EQUIPMENT DME INTERROGATORS Final Report, Oct. 1975 - Sep. 1976

John Gallagher, William Lynn, and Robert H. Pursel Nov. 1977 55 p

(FAA Proj. 073-320-100)

(AD-A049277; FAA-NA-77-28; FAA-RD-77-135) Avail: NTIS HC A04/MF A01 CSCL 01/4

Laboratory and flight tests were conducted to investigate the derivation of aircraft groundspeed from the range rate pulse information obtained from ARINC 568 distance measuring equipment (DME) interrogators. Initial tests determined the limitation of the range rate pulse output from the two interrogators tested. Subsequent effort was directed toward digital filtering techniques to improve accuracy and response time of the DME-derived groundspeed. Best results were obtained with either accelerometer complementation or Kalman filtering with velocity and acceleration observations. Both techniques achieved standard deviations of about 3 knots when compared to inertial navigation system groundspeed. Author

N78-19090# Lincoln Lab., Mass. Inst. of Tech., Lexington.

A HARDWARE IMPLEMENTATION OF THE ATCRBS REPLY PROCESSOR USED IN DABS

R. G. Nelson and J. H. Nuckols 19 Sep. 1977 58 p refs

(Contracts DOT-FA-72WAI-621; F196228-76-C-0002; FAA Proj. 034-241-012)

(AD-A047622/6; ATC-78; FAA-RD-77-92) Avail: NTIS HC A04/MF A01 CSCL 17/7

A special-purpose digital hardware processor, which implements the ATCRBS reply processing algorithms designed for use in the Discrete Address Beacon System (DABS) was developed and used in two DABS-related programs. A detailed functional description of this processor and its implementation is reported.

It could serve as the ATCRBS reply processor for a beacon collison avoidance system with minor modifications. Author

N78-19091# Coast Guard Research and Development Center, Groton, Conn.
A FEASIBILITY STUDY OF AERIAL IMAGING TECHNIQUES FOR PRECISE AIDS TO NAVIGATION POSITION DETERMINATION Final Report
F. Giovane Dec. 1977 22 p refs
(AD-A049047; CGR/DC-33/77; USCG-D-87-77) Avail: NTIS HC A02/MF A01 CSCL 17/7

An investigation of the feasibility of using aerial imaging techniques for verifying precisely the positions of aids to navigation was conducted. It was determined that such a method is technically feasible using cartographic aerial photography and precise photogrammetric data reduction. However, such a system would be impractical and expensive for Coast Guard use on a routine basis. Author (GRA)

N78-19092# Proteon Associates, Inc., Waltham, Mass.
PERSPECTIVE NAVIGATION SYSTEM Final Report, Aug. 1975 - May 1977
Howard Salwen and Henry Arbour Griffiss AFB, N. Y. RADC Oct. 1977 116 p
(Contract F19628-76-C-0040)
(AD-A049260; A117-E; RADC-TR-77-345) Avail: NTIS HC A06/MF A01 CSCL 17/7

This report describes a perspective navigation system which employs a K-band interferometer mounted on an aircraft or similar platform. The interferometer measures angle of arrival of signals from an array of six ground mounted transmitters. The angle measurement data is processed by a least-squares algorithm which computes the position and orientation of the ground array relative to the interferometer coordinate system. A perspective display of the ground array is generated based on the derived position/orientation data. The system is designed to operate at extremely low elevation angles where multipath is the dominant problem. An experimental effort was carried out to demonstrate the techniques. The results obtained are included in the report. System errors were shown to be small enough to allow aircraft landing based on the perspective display data under worst-case conditions. Author (GRA)

N78-19093# Defense Documentation Center, Alexandria, Va.
INERTIAL NAVIGATION Report Bibliography, Nov. 1956 - Apr. 1977
Jan. 1978 214 p refs
(AD-A049100; DDC/BIB-77/14) Avail: NTIS HC A10/MF A01 CSCL 17/7

This bibliography contains unclassified-unlimited citations on Inertial Navigation. These citations pertain to instrumentation, application, alignment, reliability, feasibility, cost effectiveness, test and evaluation of inertial navigation, and information on the Doppler inertial navigation system. The four computer-generated indexes provided are Corporate Author-Monitoring Agency, Subject, Title and Personal Author. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

N78-19094*# McDonnell-Douglas Corp., St. Louis, Mo.
CONCEPTUAL DESIGN STUDY OF A HARRIER V/STOL RESEARCH AIRCRAFT
Waldemar E. Bode, Roger L. Berger, Glen A. Elmore, and Thomas R. Lacey Feb. 1978 293 p
(Contract NAS2-9748)
(NASA-CR-152086) Avail: NTIS HC A13/MF A01 CSCL 01C

MCAIR recently completed a conceptual design study to define modification approaches to, and derive planning prices for the conversion of a two place Harrier to a V/STOL control, display and guidance research aircraft. Control concepts such as rate damping, attitude stabilization, velocity command, and cockpit controllers are to be demonstrated. Display formats will also be investigated, and landing, navigation and guidance systems flight tested. The rear cockpit is modified such that it can be quickly adapted to faithfully simulate the controls, displays and handling qualities of a Type A or Type B V/STOL. The safety pilot always has take command capability. The modifications studied fall into two categories: basic modifications and optional modifications. Technical descriptions of the basic modifications and of the optional modifications are presented. The modification plan and schedule as well as the test plan and schedule are presented. The failure mode and effects analysis, aircraft performance, aircraft weight, and aircraft support are discussed. Author

N78-19095# Royal Aircraft Establishment, Farnborough (England).
ICING ON HELICOPTERS
Karl Wagner Jul. 1977 15 p Transl. into ENGLISH from Flug-Rev. Int. (West Ger.), v. 9, 1971 p 31-34
(RAE-Trans-1911; BR60629) Avail: NTIS HC A02/MF A01

Some of the problems peculiar to helicopters were discussed. Emphasis was placed on the vulnerability of the rotor. A simple hypothesis for a safety criterion for the rotor was presented. Three encounters were cited; two which seemed to confirm the hypothesis and one which did not. The discrepancy was explained by distinguishing between icing due to large drops of supercooled rain and icing due to small drops of very fine drizzle or fog. The mechanisms of icing at these two conditions were briefly discussed. Author

N78-19096*# Rockwell International Corp., Los Angeles, Calif.
STUDY OF HYPERSONIC PROPULSION/AIRFRAME INTEGRATION TECHNOLOGY Final Report
William R. Hartill, Thomas P. Goebel, and Verle V. VanCamp Jan. 1978 97 p refs
(Contract NAS1-14859)
(NASA-CR-145321; NA-78-24) Avail: NTIS HC A05/MF A01 CSCL 01C

An assessment is done of current and potential ground facilities, and analysis and flight test techniques for establishing a hypersonic propulsion/airframe integration technology base. A Mach 6 cruise prototype aircraft incorporating integrated Scramjet engines was considered the baseline configuration, and the assessment focused on the aerodynamic and configuration aspects of the integration technology. The study describes the key technology milestones that must be met to permit a decision on development of a prototype vehicle, and defines risk levels for these milestones. Capabilities and limitations of analysis techniques, current and potential ground test facilities, and flight test techniques are described in terms of the milestones and risk levels. Author

N78-19097# General Dynamics/Convair, San Diego, Calif.
DEVELOPMENT OF THERMOPLASTIC COMPOSITE AIRCRAFT STRUCTURAL ELEMENTS Final Report, Jun. 1975 - Dec. 1976
R. C. Goad May 1977 72 p refs
(Contract N62269-75-C-0386)
(AD-A048468; NADC-77187-30) Avail: NTIS HC A04/MF A01 CSCL 11/9

This work accomplished the design, fabrication, and testing of structural panels of representative thermoplastic construction suitable for use in the forward fuselage areas of advanced CTOL and V/STOL carrier-based Naval aircraft. Author (GRA)

N78-19098# Hughes Aircraft Co., Culver City, Calif. Display Systems Lab.
DEVELOPMENT OF A PROGRAMMABLE PANEL Final Report, 15 Jun. 1975 - 15 Jul. 1976
G. Wolfson Aug. 1977 31 p refs
(Contract N62269-75-R-0372)
(AD-A048469; HAC-P77-383; HAC-REF-D4443; NADC-77264-30) Avail: NTIS HC A03/MF A01 CSCL 14/2

A programmable control panel utilizing a liquid crystal alphanumeric display with four lines of twenty characters each was designed and fabricated. The panel features ten pushbuttons with the liquid crystal display providing two lines of four characters

each as a programmable pushbutton legend. This panel was designed to demonstrate liquid crystal alphanumeric display technology as applied to advanced integrated controls and displays for future Navy avionics systems. Author (GRA)

N78-19099*# Naval Postgraduate School, Monterey, Calif.
PROCEEDINGS OF THE NAVY/NASA VSTOL FLYING QUALITIES
C. J. Mazza (NADC, Warminster, Pa.), D. M. Layton, and L. V. Schmidt Aug. 1977 550 p refs Proc. held at Monterey, Calif., 26-28 Apr. 1977; sponsored by NADC and NASA
(NASA-CR-155810; AD-A047961) Avail: NTIS HC A23/MF A01 CSCL 01C

Flying qualities of V/STOL aircraft used in Navy operations are reviewed. Topics discussed include: aircraft development and flight testing; flight controls and displays; and seaborne launch and recovery interface. For individual titles, see N78-19100 through N78-19120.

N78-19100*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A COMPARISON OF V/STOL HANDLING REQUIREMENTS WITH THE VAK-191B
Seth B. Anderson *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 3-20 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

The two available V/STOL criteria references were compared with flight measurements obtained on the VAK-191B along with the pilot's comments relative to the aircraft meeting the specifications. Differences in the specifications themselves were also noted. Handling qualities requirements for shipboard operation were emphasized. Author

N78-19101*# McDonnell Aircraft Co., St. Louis, Mo.
MIL-F-83300; VIEW FROM AN AIRCRAFT DESIGNER
T. R. Lacey *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 21-52 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

The MIL-F-83300 V/STOL Flying Qualities Specification is reviewed from three aspects: (1) its effectiveness as a guide to the attainment of well balanced V/STOL aircraft design; (2) the relevance of its requirements to the successful emergence of the Harrier; and (3) its relative merits and deficiencies when compared to the AGARD V/STOL Handling Criteria. Suggested changes for making it a more useful tool for the V/STOL aircraft designer are presented. Author

N78-19102*# Grumman Aerospace Corp., Bethpage, N.Y.
V/STOL HOVER STABILITY IMPACT ON HOVER CONTROL TASK
A. B. Whitaker, C. P. Kelly, R. B. Wittman, and R. P. Martorella *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 53-70 ref (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Longitudinal static stability requirements for V/STOL aircraft are discussed in terms of vertical landing on a small ship at night, response of the aircraft to air turbulence, and hovering flight. The increased pilot workload encountered under these flight conditions is considered. Results of a flight simulation study performed to evaluate a specific hover control task, two control systems - attitude rate command and translational velocity command, and the pilots' performance with and without turbulence are reported. It is concluded that the translational velocity command system provides the control requirements for good spot hovering capability and reduced pilot workload. J.M.S.

N78-19103*# Aeroplane and Armament Experimental Establishment, Boscombe Down (England).
V/STOL FLYING QUALITIES REQUIREMENTS IN THE UK
John R. Williams *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 71-92 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Acceptance and suitability testing is discussed in relation to providing a numerical basis for quantitative assessments and, together with measured aircraft characteristics, the formulation of flying qualities requirements and design criteria for V/STOL aircraft. Harrier handling qualities during short takeoff and semi-jetborne flight are assessed with emphasis on longitudinal stability, maneuverability, and pilot compensation. Flight safety is also considered. A restriction of the short takeoff nozzle angle to a maximum of 50 deg instead of the 60 deg specified by the flight manual is proposed. Results of flight tests and pilot ratings for various configurations and the two techniques indicate that the proposed technique improved significantly the handling qualities of the outboard stores configuration during short takeoffs. J.M.S.

N78-19104*# Naval Air Systems Command, Washington, D. C.
REVIEW OF US NAVY VSTOL HANDLING QUALITIES REQUIREMENTS
Dale E. Hutchings *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 93-110 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Handling qualities requirements for V/STOL operations from small ships are considered in terms of the ship operating environment. Turbulence, wind over the deck, ship motion, visibility, and severe weather and sea conditions are among the factors discussed. J.M.S.

N78-19105*# Calspan Corp., Buffalo, N. Y.
CAPABILITIES OF THE NAVY VARIABLE STABILITY X-22A FOR V/STOL FLYING QUALITIES R AND D
Edwin W. Aiken, John L. Beilman, J. Victor Lebacqz, and John W. Clark, Jr. (NADC, Warminster, Pa.) *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 111-138 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

The X-22A V/STOL Flight Research Facility which provides in-flight simulation capability applicable to hover, low speed, and transition flight investigation of fixed wing V/STOL flying is described. The variable stability system, the guidance and display equipment, the data acquisition and processing system, and the ground simulator are included. Research programs involving the STOL flying qualities for landing approach, the control system, display, and guidance requirements for VTOL aircraft instrument approach and landing, and the expansion of the adverse weather operation capabilities of the Navy's VTOL aircraft are briefly summarized. J.M.S.

N78-19106*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PILOTED SIMULATION OF V/STOL LANDINGS ABOARD A NON-AVIATION SHIP
Ronald M. Gerdes *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 139-158 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

A lift fan simulation program was conducted to examine V/STOL handling qualities and operational problems, to find solutions to high pilot workload problem areas, and to simulate terminal guidance and control of a landing on a nonaviation ship. Piloting aids evaluated include an advanced attitude control system, a decoupled flight path control system, and an integrated head-up display. Results are discussed from a pilot's point of view with emphasis on reduction of pilot workload during V/STOL aircraft recoveries at sea. J.M.S.

N78-19107*# Royal Aircraft Establishment, Bedford (England).
THE STO DECK LAUNCH PROBLEM
O. P. Nicholas *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 159-176 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Harrier aircraft launch performance is assessed. Ship pitching motion, deck-end speed, target launch speed margin, and minimum sea clearance are among the factors considered. Avoidance of a bow-down catapult launch is emphasized. J.M.S.

N78-19108*# Naval Air Test Center, Patuxent River, Md.
SHIPBOARD TESTING OF THE AV-8A HARRIER

A. M. Rossetti and J. E. Iles *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 177-200 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Minimum end airspeed flying qualities and performance, optimum STO trim settings, and effects of mistrim on STO flying qualities are discussed along with dynamic interface (STO, VTO, VL), approach and VL flying qualities, and effects of inboard tanks in combination with outboard stores. The reaction control system, center of gravity, aircraft loading, nozzle angle, and airspeed are considered. The influence of pilot workload on the optimum trim setting and the post launch flying qualities are included. J.M.S.

N78-19109*# Vought Corp., Dallas, Tex.
ANALYSIS OF THE INFLUENCE OF THE OGE/IGE TRANSITION ON VAK-191B FLYING QUALITIES IN HOVER
Robert L. Fortenbaugh *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 201-236 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Single axis pitch and roll frequency response data were taken with the VAK-191B control system in the VTOL mode. This mode has proportional attitude command in each axis. Therefore, while the pitch axis input command was oscillated, the roll control system attempted to hold wings level and, similarly, while the roll axis input command was oscillated, the pitch control system attempted to maintain a reference attitude. The yaw axis of the pedestal was locked for these tests because the aircraft yaw control system is rate command in all modes and would allow aircraft heading to drift in the presence of yaw moment disturbances. Analysis of the roll response data which produced quantification of the in ground effect (IGE) propulsion-induced roll angle effect on the aircraft and subsequent analysis of the influence of this effect on roll flying qualities are described. Validity of the analytical flying qualities results and the IGE and out of ground effect roll models is established by comparison with VAK-191B operational limitations and pilot comments on the aircraft's handling characteristics. A similar analysis of the pitch response data was made and figures summarizing these results are included. Author

N78-19110*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOT CENTERED REQUIREMENTS IN CONTROL/DISPLAY DESIGN
Ronald A. Hess *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 237-258 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

A method developed for predicting pilot opinion ratings for particular vehicles and tasks using optimal control pilot model is described and an outline of a flight director design procedure based upon the optimal control pilot model is given. Longitudinal and lateral control of a helicopter in hover and in a -6 deg constant ground speed-command landing approach are considered. Emphasis is placed on display design for optimum V/STOL control. J.M.S.

N78-19111*# Systems Technology, Inc., Hawthorne, Calif.
SURVEY OF PILOTING FACTORS IN V/STOL AIRCRAFT WITH IMPLICATIONS FOR FLIGHT CONTROL SYSTEM DESIGN
Robert F. Ringland and Samuel J. Craig *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 269-292 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Flight control system design factors involved for pilot workload relief are identified. Major contributors to pilot workload include configuration management and control and aircraft stability and response qualities. A digital fly by wire stability augmentation, configuration management, and configuration control system is suggested for reduction of pilot workload during takeoff, hovering, and approach. J.M.S.

N78-19112*# McDonnell Aircraft Co., St. Louis, Mo.
RATIONALE FOR SELECTION OF A FLIGHT CONTROL SYSTEM FOR LIFT CRUISE FAN V/STOL AIRCRAFT
Roman K. Konsewicz *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 293-342 (For availability see N78-19099 10-05)
(GP77-0375-28) Avail: NTIS HC A23/MF A01 CSCL 01C

Various features of the lift cruise fan V/STOL concept are briefly reviewed. The ability to operate from small ships in adverse weather, low visibility, and rough sea conditions is emphasized as is the need for a highly capable, flexible, and reliabile flight control system. A three channel control by wire, digital flight control system is suggested. The requirement for automatic flight control, the advantage of control by wire implementation, the preference for a digital computer, and the need for three channel redundancy are among the factors discussed. J.M.S.

N78-19113*# Boeing Military Airplane Development Seattle, Wash.
PRELIMINARY DESIGN OF A FLIGHT CONTROL SYSTEM FOR A V/STOL AIRPLANE WITH GEARED VARIABLE PITCH FANS
Philip Gotleib *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 343-362 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

A flight control system designed for an aircraft powered by three variable pitch fans, interconnected by shafts to provide lifting system redundancy is considered for application to a Navy Type A V/STOL aircraft with similar configurational features. The differences and similarities in the applications are discussed with emphasis on a design approach for safety in the event of failures in the propulsion and flight control systems. Differences in flying qualities and system design criteria are considered. Author

N78-19114*# Honeywell, Inc., Minneapolis, Minn. Avionics Div.
ELECTRONICS PLUS FLUIDICS FOR V/STOL FLIGHT CONTROL
Russell C. Hendrick *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flight Qualities Aug. 1977 p 363-386 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

The redundant digital fly by wire flight control system coupled with a fluidic system, which uses hydraulic pressure as its signal transmission means to provide pilot and feedback sensor control of airframe forcing functions is considered for application to the V/STOL aircraft. A potential fluidics system is introduced, and anticipated performance, weight, and reliability is discussed. Integration with the redundant electronic channels is explored, with the safety and mission reliability of alternate configurations estimated. Author

N78-19115*# Boeing Vertol Co., Philadelphia, Pa.
THE HELICOPTER/SHIP DYNAMIC-INTERFACE PROBLEM: A NEW APPROACH
Theodore S. Garnett, Jr. and James M. Davis *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 387-406 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

A wind tunnel test was conducted in the Boeing Vertol low speed V/STOL tunnel to assess aerodynamic wake turbulence behind the superstructure of a 1/50-scale FF1052-class U.S. Navy frigate. Dynamic velocity data were measured at a sufficient number of locations in the separated wake to define major areas of turbulence affecting helicopter operations aboard ship. The results are to be applied in piloted flight simulation work aimed at solving ship/helicopter dynamic-interface problems. The testing accomplished to map the turbulent wake is documented and results are presented. Author

N78-19116*# Naval Postgraduate School, Monterey, Calif.
A SUMMARY OF SHIP DECK MOTION DYNAMICS AS APPLIED TO VSTOL AIRCRAFT
A. E. Baitis *In its* Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 407-460 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Ship deck motions are considered in terms of the landing/

takeoff of V/STOL aircraft from small ships. Fluctuations in the air turbulence shed by the ship's superstructures, wind direction and velocity, and wind turbulence loads on the aircraft are among the factors discussed. Roll stabilization using antiroll tanks, fins, and rudders is covered. J.M.S.

N78-19117*# Center for Naval Analyses, Washington, D.C.
SEAKEEPING CONSIDERATIONS IN THE EMPLOYMENT OF V/STOL ON NAVAL SHIPS
S. R. Olson *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 461-476 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Compatibility of Naval ships as V/STOL support platforms and the ship motions that V/STOL aircraft must endure are discussed. A methodology which evaluates the impact of motion criteria such as the maximum ship motion allowable during V/STOL landing/launch is presented. Emphasis is given to design alternatives that reduce ship motion. J.M.S.

N78-19118*# Naval Air Systems Command, Washington, D. C. Launch/Recovery Branch.
REQUIREMENTS FOR VLA SYSTEMS
Noel S. Flynn *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 477-494 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

The effectiveness of visual landing aid (VLA) systems during the approach and landing flight phase of V/STOL aircraft is examined. Baseline requirements for VLA systems are determined. J.M.S.

N78-19119*# Naval Ocean Systems Center, San Diego, Calif.
VTOL/HELICOPTER APPROACH AND LANDING GUIDANCE SENSORS FOR NAVY SHIP APPLICATIONS
S. K. Miyashiro and F. E. Morris *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 495-514 (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

Approach and landing guidance sensors essential to recover V/STOL aircraft and helicopter on ships are described. Alternative techniques which feature different operating frequencies from microwave to optical-infrared, different geometric techniques of position fixing by range and angle measurements from a single point or points on a short baseline available at the landing platform typically forty feet wide are included. Other factors discussed include ceiling/visibility requirements, in-close accuracy, safety and pilot acceptance, and compatibility with air traffic control and landing systems. J.M.S.

N78-19120*# Naval Air Systems Command, Washington, D. C. Advanced Aircraft Development and Systems Objectives Office.
NAVTOLAND AND FLYING QUALITIES
Thomas S. Momiyama *In* Naval Postgraduate School Proc. of the Navy/NASA VSTOL Flying Qualities Aug. 1977 p 515-546 refs (For availability see N78-19099 10-05)
Avail: NTIS HC A23/MF A01 CSCL 01C

The V/STOL operational capability is reviewed with emphasis on pilot workload and all-weather landing guidance systems. A research and development program to correlate and integrate the development of all systems and techniques involved in enabling the pilot to fly V/STOL aircraft onto ships and tactical sites is described. Aircraft design parameters that affect its control in the vertical takeoff and landing flight regimes are emphasized. Topics considered include: (1) integrated flight controls and displays; (2) low speed sensor; (3) air traffic control approach and landing guidance systems; (4) visual landing aids; (5) ground effect induced thrust variation problems; and (6) handling qualities. J.M.S.

N78-19121# McDonnell Aircraft Co., St. Louis, Mo.
GENERALIZED PROCEDURES FOR TRACKING CRACK GROWTH IN FIGHTER AIRCRAFT Final Technical Report, 15 Sep. 1975 - 15 Oct. 1976
G. S. Parker Jan. 1977 178 p refs
(Contract F33615-75-C-3136; AF Proj. 1367)
(AD-A048847; AFFDL-TR-76-133) Avail: NTIS HC A09/MF A01 CSCL 11/6

This study is composed of three major parts, (1) effects of usage parameters on crack growth, (2) development of generalized procedures, and (3) implementation of the tracking program. During the development of generalized procedures, crack growth trends and alternate methods of tracking were established. In addition, the recorded data requirements have been evaluated. The effort regarding implementation of a tracking program consisted of an evaluation of logistics and the identification of technical difficulties and potentially significant costs.
Author (GRA)

N78-19122# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DESIGN AND EVALUATION OF A SIDE FORCE GENERATOR MODIFICATION FOR THE XBQM-1 REMOTELY PILOTED VEHICLE
Glenn R. Leimbach Dec. 1977 136 p refs
(AD-A048901; AFIT/GAE/AA/77D-7) Avail: NTIS HC A07/MF A01 CSCL 01/3

Wingtip and fuselage mounted side force generator (SFG) surfaces were designed and installed on the XBQM-106 remotely piloted vehicle (RPV) to enhance its lateral terminal response characteristics. These surfaces were sized and positioned in an attempt to keep the net rolling and yawing moments about the CG unchanged when the aircraft was side slipping. The FLEXSTAB digital computer system in conjunction with traditional hand calculated method was used to evaluate the RPV's stability, control, and time response characteristics. The time history responses to rudder, aileron, rudder/aileron, and wind gust inputs were generated and plotted by the FLEXSTAB program. From these plots it was determined that the SFG modification increased the yaw rate response 10.6% while decreasing the roll rate 10.7% and the side slip angle response 25.1%. The dutch roll damping was increased 4% and the DR period decreased 8%. The roll mode time to half amplitude increased 16.7% and the spiral stability increased for the modified vehicle. The longitudinal stability suffered a slight decrease due to the SFG.
Author (GRA)

N78-19123# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A FEASIBILITY STUDY OF A MANUAL BOMB RELEASE WHILE IN A TURN M.S. Thesis
Joel Dana Walton Dec. 1977 123 p refs
(AD-A048882; AFIT/GAE/AA/77D-17) Avail: NTIS HC A06/MF A01 CSCL 15/7

This study attempts to determine if a pilot can manually release a bomb while in a turn. The nonlinear equations describing the geometry, fire control law, aircraft equations of motion, flight controls and pilot model are developed. These equations are linearized so that a frequency response analysis can be conducted for perturbations about a nominal trajectory. The system response is evaluated using wind gust inputs and lateral stick inputs and plotting the resulting system perturbations over a given frequency range.
Author (GRA)

N78-19124# Hughes Helicopters, Culver City, Calif.
ADVANCED TECHNOLOGY HELICOPTER LANDING GEAR Final Report, Apr. 1975 - Apr. 1977
Ralph E. Goodall Oct. 1977 150 p refs
(Contract DAAJ02-75-C-0028)
(AD-A048891; HH-77-41; USAAMRDL-TR-77-27) Avail: NTIS HC A07/MF A01 CSCL 01/3

This report covers the work performed on the advanced helicopter landing gear program by Hughes Helicopters. The objectives of the program were to design, fabricate, and test a wheel-type advanced main landing gear concept possessing high-energy-absorbing characteristics for helicopters in the 15,000-pound class. These objectives were achieved by formulating design criteria through a data search, choosing the most cost-effective composite material, and through a design analysis, selecting the most promising landing gear concept. This concept used graphite epoxy as a structural material to fabricate the trailing arm of the main landing gear of the Hughes YAH-64 helicopter by wet-filament winding (WFW). The graphite arm was successfully tested, demonstrating the practicality of employing composite structures in the construction of high-energy-

attenuating landing gear components. The program showed that the graphite trailing arm was 11 percent lighter than the baseline steel arm. The weight of the baseline landing gear could be reduced by maximizing the use of composites: 7 percent by using existing WFW equipment, and 26 percent by developing and using a toroid winding machine. Author (GRA)

N78-19125# Kearney (A. T.) and Co., Inc., Chicago, Ill. Caywood-Schiller Div.
THE MISSION TRADE-OFF METHODOLOGY (MTOM) MODEL. MODEL DESCRIPTION Final Report
W. J. Strauss, N. D. Bailey, and M. W. Kasper Dec. 1977 126 p refs
(Contract F33615-74-C-5141)
(AD-A049318; JTCG/AS-76-S-001) Avail: NTIS HC A07/MF A01 CSCL 01/3

Presented are the results, assumptions and rationale of a model to evaluate the relative cost-effectiveness of proposed aircraft modifications for survivability enhancement. Two primary questions are addressed: how effective are the proposed modifications in a mission context and what are the important factors contributing to the improvement. To answer these questions, the MTOM model was developed. Parametric variations are presented and analyzed. Author (GRA)

N78-19126# Advisory Group for Aerospace Research and Development, Paris (France).
ROTORCRAFT DESIGN
Jan. 1978 342 p refs Proceedings of the Flight Mechanics Panel Symp., Moffett Field, Calif., 16-19 May 1977
(AGARD-CP-233; ISBN-92-835-1272-3) Avail: NTIS HC A15/MF A01

Military and civilian rotorcraft designers are provided with exchanges concerning common problems and grounds for civil/military cooperation. Sessions included military requirements and new rotorcraft systems; civil operations and new helicopter designs; and research vehicles. Rotor wind tunnel and flight research are also reviewed, and opportunities for coordinating military and civil requirements and specifications are discussed. For individual titles, see N78-19127 through N78-19151.

N78-19127# Army Aviation Systems Command, St. Louis, Mo.
PROJECTED NEEDS OF US ARMY AVIATION
Story C. Stevens *In* AGARD Rotorcraft Design Jan. 1978 22 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The projected needs of U.S. Army air mobility as they are seen today within the U.S. Army Aviation Systems Command are reviewed. The U.S. Army's envisioned future aviation requirements are discussed and their relation to research and development needs is summarized. Special emphasis is given to those aspects of the military requirements which seem to offer the best opportunities for coordination with civil developments. Both the short term needs, as exemplified by the currently developing systems, and the long term requirements, which may be represented by conceptual studies only, are addressed. Author

N78-19128# Bundesministerium der Verteidigung, Bonn (West Germany).
GERMAN ARMY HELICOPTER DEVELOPMENT AND PROSPECTS FOR THE FUTURE
K. W. Mack and H. Jakob *In* AGARD Rotorcraft Design Jan. 1978 22 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The present German army helicopter development is concentrated on a light antitank helicopter (ATH) and a liasion-and-observation helicopter (LOH), based on the civilian BO 105 helicopter of Messerschmitt-Bolkow-Blohm. The outstanding characteristics of these two systems is a high degree of commonality that is promising considerable advantages for cost effectiveness, maintenance, overhaul and other logistic aspects. Guidelines for the future German military helicopter development are among others: night- and bad-weather capability; increased maneuverability; improved survivability and crashworthiness; improved maintenance, overhaul and repair; reduction of the number of types; and consideration of standardization and interoperability requirements. Author

N78-19129# Canadian Forces Base, Shearwater (Nova Scotia).
CANADIAN NAVY EXPERIENCE WITH SMALL SHIP HELICOPTER OPERATIONS
N. H. J. Browne *In* AGARD Rotorcraft Design Jan. 1978 4 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

A short summary is presented of the development of the Canadian Navy's approach and solution to operating medium size helicopters from small ships in the North Atlantic. This is followed by a general description of the Helicopter Hauldown Rapid Securing Device - the main item of equipment which enabled successful open sea operations with the available equipment. An overview of the operating capabilities of the Destroyer/Helicopter system, the lessons learned from its development and a subjective assessment of future helicopter requirements for the Canadian Navy are also offered. Author

N78-19130# Ministry of Defence, London (England). Directorate of Naval Air Warfare.
BRITISH MILITARY HELICOPTER PROGRAMMES
J. D. W. Husband *In* AGARD Rotorcraft Design Jan. 1978 7 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The range of helicopters in current use within the UK armed services is described and the broad requirements for the future are examined. It is recognized that, because of the spiralling cost of development of new helicopters, every effort will have to be made to reduce the through life costs by improving the life, reliability and maintainability of components. Survivability, both in crash resistance and in reduced vulnerability to hostile fire are of particular importance in the battlefield environment, while increased speed and endurance are sought in naval helicopters. Author

N78-19131# Army Aviation Systems Command, St. Louis, Mo. Research, Development and Engineering Directorate.
THE US ARMY UTTAS AND AAH PROGRAMS
Ronald F. Gormont and Robert A. Wolfe *In* AGARD Rotorcraft Design Jan. 1978 18 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The U. S. Army's latest developed utility and attack helicopters with contracts recently awarded to Sikorsky Aircraft for the utility tactical transport aircraft system (UTTAS) and Hughes Aircraft for the advanced attack helicopter (AAH) are addressed. A brief history into the background of the Army's requirement for a UTTAS and AAH is provided along with a history of the development, a general description of the aircraft with intended missions, planned activities, significant capabilities, and potential alternate uses of the resulting designs. The capabilities and potential alternate uses consider the implication of the stringent military requirements in adapting the UTTAS and AAH to other nonmilitary or noncombat missions. Both development programs have concentrated efforts on reliability and maintainability characteristics which provide enhanced operational capability on the modern day battlefield at an affordable cost. Author

N78-19132# Department of the Navy, Washington, D. C.
US NAVY/MARINE CORPS ROTARY WING REQUIREMENTS
J. A. Purtell *In* AGARD Rotorcraft Design Jan. 1978 4 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

Points addressed include how rotorcraft fit into a Navy committed to a future VTOL force, current helicopter developments in Naval aviation with emphasis upon characteristics and capabilities of CH-53E Super Stallion, LAMPS MK III, and the AH-1T improved Sea Cobra, and finally, what current trends are underway in navalized helicopters to applications. Author

N78-19133# British Airways Helicopters Ltd., Horley (England).
BRITISH AIRWAYS HELICOPTER OPERATIONS
J. A. Cameron *In* AGARD Rotorcraft Design Jan. 1978 4 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The helicopter's role in civil aviation in the United Kingdom is assessed. The main operation considered is a helicopter passenger service from Penzance on Britain's south west coast

to the Isles of Sicily. A comparison is made between fixed wing aircraft and rotary wing aircraft in regard to operating costs and flight time reduction. Other aspects of operations economics are examined, including helicopter design, fleet maintenance and overhaul life. B.L.P.

N78-19134# Squadron 330/B-Wing, Banak AFB, Laksalv (Norway).
AIR-SEA RESCUE OPERATIONS. SEARCH AND RESCUE EXPERIENCE
Tore Skaar *In* AGARD Rotorcraft Design Jan. 1978 8 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The 330th squadron operates Sea King helicopters for air-sea rescue missions all along the Norwegian coast. The operational environment is one of the most demanding in the world. The shortcomings of the present generation of helicopters are discussed, the most serious being the lack of in flight icing protection of the rotor systems. Author

N78-19135# KLM North Sea Helicopters, Amsterdam (Netherlands).
SOME ASPECTS OF OFFSHORE OPERATIONS IN THE NETHERLANDS
R. J. VanDerHarten *In* AGARD Rotorcraft Design Jan. 1978 7 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The sound film 'Bridging the Troubled Waters' (Sikorsky Aircraft), which gives a general impression of helicopter operations between mainland and naval destinations, is summarized. Problems which had to be solved in order to realize the required services on a 24-hour basis are reviewed. One of these problems was the certification of helicopter weather minima for IFR-flight. This involved the development and evaluation of instrument procedures and the proper choice of instruments and panel layout, the navigational aids and the communication system. Special attention was paid to the radar system, which provides not only weather detection but is also used during the approach to the targets at sea, as well as to the recent evaluation of an integrated pilot display system, which has a great potential for very low weather minima without the use of automatic guidance. Author

N78-19136# Hughes Helicopters, Culver City, Calif.
COMBINED MILITARY AND COMMERCIAL APPLICATION OF LIGHT HELICOPTERS
E. E. Cohen, K. B. Amer, and R. E. Moore *In* AGARD Rotorcraft Design Jan. 1978 21 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

An overview is presented of light helicopters of less than 4000 pounds gross weight used by both military and commercial aviation. Hughes Helicopters background in light helicopters, the design considerations and criteria used in the development of these helicopters, and the Army's entry into light helicopter development are considered as well. Some conjecture is offered on the design considerations and criteria which might be used to develop a next generation lightweight, multipurpose helicopter which could be used suitably by both military and commercial aviation. Author

N78-19137# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
LONG TERM EXPERIENCE WITH A HINGELESS/ COMPOSITE ROTOR
G. Reichert and E. Weiland *In* AGARD Rotorcraft Design Jan. 1978 14 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The Messerschmitt-Bolkow-Blohm Company has gained good experience with its light helicopter MBB - BO 105, which is engaged in civilian as well as in military operations. Up to now, more than 300 BO 105 helicopters have been delivered to customers, and some 250,000 hours of flight time have been accumulated. The first helicopters have about 5,000 flight hours. This experience is especially valuable because the BO 105 is the first production helicopter with a hingeless rotor and fiberglass rotorblades which has been able to prove its ability in practical operation consistently over a long period of time. The broad spectrum of operation and experience includes the following types of missions in civilian operation: utility, executive, rescue, police, offshore, lighthouse supply as well as LOH, scout and antitank-missions in military operation. Besides the problems resulting from this broad field of operations, which are typical for many light helicopters, additional questions associated with the new technology were specially considered, for example the changed handling characteristics and the different loading situation of the hingeless rotor, and the behavior of the fatigue loaded fiberglass blades. Author

N78-19138# Textron Bell Helicopter, Ft. Worth, Tex.
THE BELL MODEL 222
James R. Garrison *In* AGARD Rotorcraft Design Jan. 1978 16 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The design objectives, features and performance of the recently developed Bell Model 222 helicopter are described. The Model 222 was designed to meet the needs of the worldwide commercial market. Primary design objectives were safety, efficiency, reduced cost of ownership, and superior handling qualities. From the test results, the Model 222 is a fuel conservative, productive aircraft with excellent flying qualities. The 222 far exceeds the FAA requirements for fail-safe design and crashworthiness. Redundancy, 8g seats, crash resistant fuel tanks, and real twin-engine safety are examples. The latter refers to the fact that for any altitude at which the helicopter can hover OGE, it can continue to cruise if one engine fails. Author

N78-19139# Sikorsky Aircraft, Stratford, Conn.
THE SIKORSKY S-76 PROGRAM
R. F. Donovan *In* AGARD Rotorcraft Design Jan. 1978 14 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The Sikorsky S-76 helicopter was designed for the commercial market in general, and in particular, was designed to serve the off-shore oil market and meet its requirements to carry 12 passengers and a crew of two on a 400 nautical mile radius mission with flotation equipment. Author

N78-19140# Societe Nationale Industrielle Aerospatiale, Paris (France).
THE AS 350 LIGHT HELICOPTER
Rene Mouille *In* AGARD Rotorcraft Design Jan. 1978 18 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The AS-350 was designed especially for civil operators, with cost effectiveness a major concern. Overall architectural design reduced the number of engine components, resulting in a lightweight (4200 lb), single-engined helicopter capable of carrying a crew of six. M.V.

N78-19141# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
TETHERED RPV-ROTORCRAFT
G. Kannamueller and W. Goeller *In* AGARD Rotorcraft Design Jan. 1978 7 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

A tethered rotor platform was designed for the stabilization of transmitters and receivers of electromagnetic waves at an adequate altitude over a ground control station for military and civil purposes. The complete system consisted of rotor platform, tethering cable, and ground control station. Apart from the transmission of command and information data the tethering cable was also used for the power supply. Tethered rotor platforms were used primarily in the military field for electronic warfare, fire control, communication, and surveillance of battlefield, sea surface and air space. Author

N78-19142*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EVALUATION OF THE TILT ROTOR CONCEPT: THE XV-15'S ROLE
James H. Brown, Jr., H. Kipling Edenborough (Textron Bell Helicopter, Fort Worth, Tex.), and Kenneth G. Wernicke *In* AGARD Rotorcraft Design Jan. 1978 9 p Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif. (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01 CSCL 01C

The need for an aircraft combining the efficient vertical takeoff and landing capability of a helicopter with the efficient high speed characteristics of a fixed wing turboprop is examined. The ability of the tilt rotor concept to fill this requirement and examples as to its potential usefulness in both military and civil missions are discussed. Author

N78-19143# Army Air Mobility Research and Development Lab., Fort Eustis, Va.
THE ADVANCING BLADE CONCEPT (ABC) ROTOR PROGRAM
Harvey R. Young and Duane R. Simon *In* AGARD Rotorcraft Design Jan. 1978 23 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

The advancing blade concept, a coaxial counterrotating hingeless helicopter rotor system, was flight tested. Flight results in a basic helicopter configuration confirmed several important advantages of the concept and identified some shortcomings. The background and current status of the program are presented, and rotor and test aircraft features are briefly described. Author

N78-19144*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE ROTOR SYSTEMS RESEARCH AIRCRAFT: A NEW STEP IN THE TECHNOLOGY AND ROTOR SYSTEM VERIFICATION CYCLE
Robert J. Houston, Julian L. Jenkins, Jr., and John L. Shipley (Army Air Mobility Res. and Develop. Lab., Hampton, Va.) *In* AGARD Rotorcraft Design Jan. 1978 24 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01 CSCL 01C

Rotor systems research aircraft vehicles, (RSRA), were developed specifically to provide the capabilities necessary for the effective and efficient in-flight test and verification of promising new rotor concepts and supporting technology developments. The capabilities of the RSRA aircraft for potential research programs are discussed. Author

N78-19145# National Aeronautical Establishment, Ottawa (Ontario).
THE NAE AIRBORNE V/STOL SIMULATOR
S. R. M. Sinclair, W. E. B. Roderick, and K. Lum *In* AGARD Rotorcraft Design Jan. 1978 12 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

Specialized facilities for investigating the problems associated with high-lift, low-speed flight were established. The airborne simulator's four major areas of systems development are discussed: installation of an electrohydraulic actuator system to interface with the basic helicopter controls, development and integration of a hybrid computing system, implementation of a model-following autopilot, and development of a broadband motion sensing system. A short description of each of these systems is given. Author

N78-19146# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
DFVLR ROTORCRAFT RESEARCH
B. Gmelin, H. J. Langer, and P. Hamel *In* AGARD Rotorcraft Design Jan. 1978 17 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

Selected activities in the field of rotorcraft research and development are presented and discussed: helicopter wind tunnel test stands, active vibration control, crew escape systems, and helicopter system identification. Author

N78-19147# Westland Helicopters Ltd., Yeovil (England).
RESEARCH REQUIREMENTS FOR THE IMPROVEMENT OF HELICOPTER OPERATIONS
Martin V. Lowson *In* AGARD Rotorcraft Design Jan. 1978 13 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

Principal difficulties in helicopter performance engineering were studied. Problems in the areas of noise, both external and internal, and ice formation were examined. Reduction of rotor speed as a noise control method was suggested, and ice formation was attributed to meteorological uncertainties. Author

N78-19148# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ONERA AERODYNAMIC RESEARCH WORK ON HELICOPTERS
Jean-Jacques Philippe and Claude Armand *In* AGARD Rotorcraft Design Jan. 1978 19 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

Aerodynamic research on helicopters included basic research in two or three-dimensional flows and studies on rotors. The study of steady and unsteady characteristics of airfoils and of problems pertaining to blade tips and to vortex interactions is discussed. For the rotors, a computing program for the forces on the blades, based on the acceleration potential method was develped. The problems of unsteady transonic aerodynamics related to high speed flight are also discussed. In order to perform wind tunnel tests for helicopter companies and for research purposes two rotor test rigs were developed. Measuring techniques which were used and the more characteristic results for total forces on helicopter or convertible, for absolute pressure on the blades, for identification of the boundary layers, for smoke visualizations, and for rotating blade deformations are described. Author

N78-19149# Westland Helicopters Ltd., Yeovil (England).
WESTLAND WISP
M. J. Breward *In* AGARD Rotorcraft Design Jan. 1978 14 p ref (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

Feasibility studies for a surveillance and target acquisition system led to a proposal for a remotely piloted helicopter with co-axial twin rotors having symmetry about the rotor axis. One project which has proceeded into hardware status and which has commenced flight trials, carries a trainable television camera and gyro based automatic stabilization equipment. It is operable by two persons, one of which performs all piloting functions. Author

N78-19150# Societe Nationale Industrielle Aerospatiale, La Courneuve (France).
TECHNICAL AND FINANCIAL FALL-OUT ON ARMED FORCES FROM COMMERCIAL AND EXPORT HELICOPTER PROGRAMMES
Andre L. Renaud *In* AGARD Rotorcraft Design Jan. 1978 4 p (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

An attempt was made to highlight the drawbacks for industry, and advantages for armed forces, when launching a helicopter program as a private venture. The drawbacks for the industry lie in the investments, the lack of operational and technical specifications, and of official crew's judgement on the aircraft. The advantages for military operators were the deferred and lower non-recurring cost outlay if a helicopter was developed as a private venture. Author

N78-19151# Boeing Vertol Co., Philadelphia, Pa.
CIVIL AND MILITARY DESIGN REQUIREMENTS AND THEIR INFLUENCE ON THE PRODUCT
David G. Harding and John P. Walsh *In* AGARD Rotorcraft Design Jan. 1978 9 p refs (For availability see N78-19126 10-05)
Avail: NTIS HC A15/MF A01

Differences in airworthiness requirements were found to cause substantial cost increases, particularly for civil application of military helicopters. The effects of these differences are discussed by examing the civil certification programs of various military helicopters. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

No abstracts in this category.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

N78-19152*+ National Aeronautics and Space Administration, Washington, D. C.

THE EFFECT OF THE RADIAL GAP ON THE EFFICIENCY OF AXIAL UNSHROUDED TURBINE-STAGES

A. N. Sherstyuk and V. V. Chizhov Mar. 1978 10 p refs Transl. into ENGLISH from Energetika (USSR), v. 20, Jun. 1977 p 137-141 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Moscow Inst. of Chem. Machine Building

(Contract NASw-2790)

(NASA-TM-75267) Copyright. Avail: NTIS HC A02 CSCL 21E

A refined model of flow in the radial gap between the working blades and body of a turbine was represented and the development of a method for calculating losses in the gap on the basis of this model was shown. It was shown that the method used allows a more precise determination of turbine efficiency than relations used by other authors. Author

N78-19153*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.

ANALYSIS OF THE CROSS FLOW IN A RADIAL INFLOW TURBINE SCROLL

A. Hamed, S. Abdallah, and W. Tabakoff Nov. 1977 61 p

(Grant NsG-3066)

(NASA-CR-135320) Avail: NTIS HC A04/MF A01 CSCL 21E

Equations of motion were derived, and a computational procedure is presented, for determining the nonviscous flow characteristics in the cross-sectional planes of a curved channel due to continuous mass discharge or mass addition. An analysis was applied to the radial inflow turbine scroll to study the effects of scroll geometry and the through flow velocity profile on the flow behavior. The computed flow velocity component in the scroll cross-sectional plane, together with the through flow velocity profile which can be determined in a separate analysis, provide a complete description of the three dimensional flow in the scroll. Author

N78-19154*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.

COMPUTER PROGRAM FOR THE ANALYSIS OF THE CROSS FLOW IN A RADIAL INFLOW TURBINE SCROLL

A. Hamed, S. Abdallah, and W. Tabakoff Nov. 1977 56 p

(Grant NsG-3066)

(NASA-CR-135321) Avail: NTIS HC A04/MF A01 CSCL 21E

A computer program was used to solve the governing of the potential flow in the cross sectional planes of a radial inflow turbine scroll. A list of the main program, the subroutines, and typical output example are included. Author

N78-19155*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.

THEORETICAL AND EXPERIMENTAL STUDY OF AERODYNAMICS, HEAT TRANSFER AND PERFORMANCE OF A RADIAL TURBINE Final Report, 1 Oct. 1973 - 30 Oct. 1977

W. Tabakoff Sep. 1975 56 p refs Sponsored in part by Army Air Mobility Res. and Develop. Lab.

(Contract NAS2-7850)

(NASA-CR-152105) Avail: NTIS HC A04/MF A01 CSCL 21E

A two-dimensional finite difference numerical technique is presented to determine the temperature distribution in a solid blade of a radial turbine guide vane. A computer program is written in FORTRAN 4 for the IBM 370/165 computer. The computer results obtained from these programs have a similar behavior and trend as those obtained by experimental results. Author

N78-19156*# National Aeronautics and Space Administration, Washington, D. C.

LOW CYCLE FATIGUE IN TURBINES

M. Brun Mar. 1978 23 p refs Transl. into ENGLISH from Fatigue Oligocyclique dans les Turbomachines Mecanique Materiaux Elec. (France), no. 323-324, Nov.-Dec. 1976 p 42-50 Transl. by Kanner (Leo) Associates, Redwoood City, Calif.

(Contract NASw-2790)

(NASA-TM-75264) Avail: NTIS HC A02/MF A01 CSCL 21E

Behavior of certain components at low-cycle fatigue is a parameter related to the conditions of use of turbines, to the technology of engine production and to the precision of its regulation. The laboratory takes this into account using data from sophisticated tests and rigorous analyses. The production plan includes careful examination of possible causes of premature rupture. This parameter has motivated the metallurgy industry to develop new materials and new technology. Author

N78-19157*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PREDICTED INLET GAS TEMPERATURES FOR TUNGSTEN FIBER REINFORCED SUPERALLOY TURBINE BLADES

Edward A. Winsa, Leonard J. Westfall, and Donald W. Petrasek 1978 23 p refs Presented at 2d Intern. Conf. on Composite Materials, Toronto, Canada, 16-20 Apr. 1978; sponsored by Am. Inst. of Mining, Metallurgical, and Petroleum Engineers

(NASA-TM-73842) Avail: NTIS HC A02/MF A01 CSCL 21E

Tungsten fiber reinforced superalloy composite (TFRS) impingement cooled turbine blade inlet gas temperatures were calculated taking into account material spanwise strength, thermal conductivity, material oxidation resistance, fiber-matrix interaction, and coolant flow. Measured values of TFRS thermal conductivities are presented. Calculations indicate that blades made of 30 volume percent fiber content TFRS having a 12,000 N-m/kg stress-to-density ratio while operating at 40 atmospheres and a 0.06 coolant flow ratio could permit a turbine blade inlet gas temperature of over 1900K. This is more than 150K greater than similar superalloy blades. Author

N78-19158*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HIGH TEMPERATURE ENVIRONMENTAL EFFECTS ON METALS

S. J. Grisaffe, C. E. Lowell, and C. A. Stearns 1977 19 p refs Presented at 24th Sagamore Army Materials Res. Conf. Risk and Failure Analysis for Reliability, Bolton Landing, N. Y., 22-26 Aug. 1977

(NASA-TM-73878) Avail: NTIS HC A02/MF A01 CSCL 21E

The gas turbine engine was used as an example to predict high temperature environmental attack on metals. Environmental attack in a gas turbine engine derives from high temperature, combustion products of the air and fuel burned, and impurities. Of all the modes of attack associated with impurity effects, hot corrosion was the most complicated mechanistically. Solutions to the hot corrosion problem were sought semi-empirically in: (1) improved alloys or ceramics; (2) protective surface coating; (3) use of additives to the engine environment; and (4) air/fuel cleanup to eliminate harmful impurities. J.C.S.

N78-19159*# National Aeronautics and Space Administration, Washington, D. C.

APPROXIMATE DYNAMIC MODEL OF A TURBOJET ENGINE

O. A. Artemov Mar. 1978 9 p refs Transl. into ENGLISH from Samoletostr. Tekh. Vozdush. Flota (USSR), no. 40, 1976 p 34-37 Original language document announced as A77-32705 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(NASA-TM-75263) Avail: NTIS HC A02/MF A01 CSCL 21E

An approximate dynamic nonlinear model of a turbojet engine is elaborated on as a tool in studying the aircraft control loop, with the turbojet engine treated as an actuating component. Approximate relationships linking the basic engine parameters and shaft speed are derived to simplify the problem, and to aid in constructing an approximate nonlinear dynamic model of turbojet engine performance usefui for predicting aircraft motion. Author

N78-19160*# Pratt and Whitney Aircraft, East Hartford, Conn. Commercial Products Div.

VCE TESTBED PROGRAM PLANNING AND DEFINITION STUDY Final Report

J. S. Westmoreland and J. Godston Jan. 1978 82 p
(Contract NAS3-20048)
(NASA-CR-135362; PWA-5546-7) Avail: NTIS HC A05/MF A01 CSCL 21E

The flight definition of the Variable Stream Control Engine (VSCE) was updated to reflect design improvements in the two key components: (1) the low emissions duct burner, and (2) the coannular exhaust nozzle. The testbed design was defined and plans for the overall program were formulated. The effect of these improvements was evaluated for performance, emissions, noise, weight, and length. For experimental large scale testing of the duct burner and coannular nozzle, a design definition of the VCE testbed configuration was made. This included selecting the core engine, determining instrumentation requirements, and selecting the test facilities, in addition to defining control system and assembly requirements. Plans for a comprehensive test program to demonstrate the duct burner and nozzle technologies were formulated. The plans include both aeroacoustic and emissions testing. Author

N78-19161*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL DETERMINATION OF TRANSIENT STRAIN IN A THERMALLY-CYCLED SIMULATED TURBINE BLADE UTILIZING A NON-CONTACT TECHNIQUE

Frederick D. Calfo and Peter T. Bizon Jan. 1978 31 p refs
(NASA-TM-73886; E-9500) Avail: NTIS HC A03/MF A01 CSCL 21E

A type of noncontacting electro-optical extensometer was used to measure the displacement between parallel targets mounted on the leading edge of a simulated turbine blade throughout a complete heating and cooling cycle. The blade was cyclically heated and cooled by moving it into and out of a Mach 1 hot gas stream. The principle of operation and measurement procedure of the electro-optics extensometer are described. Author

N78-19162# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

EFFECT OF FUEL BOUND NITROGEN ON OXIDES OF NITROGEN EMISSION FROM A GAS TURBINE ENGINE Interim Report

Anthony F. Klarman and Anthony J. Rollo Dec. 1977 33 p refs
(ZF57571004)
(AD-A048382; NAPC-PE-1) Avail: NTIS HC A03/MF A01 CSCL 21/4

Fuels of varying nitrogen content were tested in a T63-A-5A engine to measure their effects on exhaust gas emissions. Five test fuels varying in fuel bound nitrogen content from 3 microgram (nitrogen)/g (fuel) to 902 microgram (nitrogen)/g (fuel) were evaluated. The nitrogen content in the fuel was adjusted by mixing a JP-5 type fuel derived from shale oil (902 microgram (nitrogen)/g (fuel)) and regular petroleum JP-5 fuel (3 microgram (nitrogen)/g (fuel)). Nitrogen content of the fuel had no effect on engine performance. The carbon monoxide and unburned hydrocarbon emissions were equivalent for all the fuels included in the test program. For the engine power ratings tested, the oxides of nitrogen emissions increased with increasing nitrogen content of the test fuel. The conversion efficiency of fuel bound nitrogen to oxides of nitrogen appears to be independent of the nitrogen content of the fuel. Difficulties in measuring small changes in oxides of nitrogen level resulting from low nitrogen content fuels (50 microgram nitrogen/g (fuel) or less) caused the conversion efficiency to be very variable. The conversion efficiency for fuels with a nitrogen content of 250 microgram (nitrogen)/g (fuel) or greater was approximately 45 percent. Author (GRA)

N78-19163# AiResearch Mfg. Co., Phoenix, Ariz.

FABRICATION AND TEST OF A FLUIDIC FUEL-CONTROL AND BLEED-AIR-LOAD-CONTROL SYSTEM FOR GAS TURBINE ENGINES Final Report, 25 Jul. 1976 - 31 Aug. 1977

T. S. Thurston Dec. 1977 41 p
(Contract DAAG39-76-C-0129)
(AD-A049039; AiResearch-41-1803A; HDL-CR-77-129-1)
Avail: NTIS HC A03/MF A01 CSCL 13/7

This program has produced a production fluidic fuel-control and bleed-air-load-control system which consists of a fuel control, a load valve, and a temperature sensor. Three sets of hardware were produced for use in a follow-on program. This hardware will be subjected to acceptance tests on the Air Research Model GTCP 85-180 gas turbine engine. The production system improved the steady-state performance over that demonstrated on the prototype control produced under the previous program. The fluidic circuits were designed to perform within specification limits when operated at altitude as well as high and low temperature conditions. Designs and drawings were modified wherever necessary to facilitate production. The system underwent engine and fuel bench testing to confirm design improvement and performance. As part of this testing, a 50-hour endurance bench test of the fuel control was performed. This test, as well as the engine tests conducted, identified minor problems with the fuel metering valve and the speed sensor which were easily corrected. The appropriate design changes were incorporated into the production configuration. The production fluidic fuel-control and bleed-air-load-control system performed satisfactorily, meeting the program and engine requirements and is therefore recommended for follow-on program testing. Author (GRA)

N78-19164# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.

SENSITIVITY OF AIRCRAFT RUNUP/COMMUNITY NOISE PREDICTIONS TO EXCESS GROUND ATTENUATION

Thomas C. Dunderdale Dec. 1977 28 p refs
(Contract F33615-76-C-0528)
(AD-A049067; AMRL-TR-77-76) Avail: NTIS HC A03/MF A01 CSCL 01/3

This study examines the sensitivity of aircraft ground runup noise predictions to the accuracy of excess ground attenuation algorithms presently used in NOISEMAP. Day/Night Level (DNL) noise exposure contours were computed for one hour of single engine military power ground runup activity by F-4, C-131, and C-5 aircraft. These aircraft were chosen since they have straight jet, low bypass ratio fan, and high bypass ratio fan engines. The propagation algorithms studied were: no excess ground attenuation, standard NOISEMAP excess attenuation, and NOISEMAP excess attenuation plus and minus one standard deviation of the field test data used to develop the present NOISEMAP algorithm. This study clearly substantiates the need for further field measurements planned by AMRL in 1977 and 1978 to refine or modify the ground propagation algorithm and establish confidence in its accuracy. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N78-19165# Northrop Corp., Hawthorne, Calif. Structural Dynamics Research Dept.

A NON-GAUSSIAN GUST MODEL FOR AIRCRAFT RESPONSE ANALYSIS

W. S. Pi and C. Hwang 8 Feb. 1978 36 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Jul. 1978
(NOR-76-223) Avail: NTIS HC A03/MF A01

The non-Gaussian model was created through a zero-memory transformation of a Gaussian process. Single or multiple transformation parameters were used to control the severity and other statistical characteristics of the non-Gaussian process. The composite nature of gust patches of various intensity was accounted for through the accumulative statistics. Methods to predict the aircraft response statistics to the non-Gaussian gust model were developed by approximating the response integral as its Riemann sum. Application of the probabilistic theory indicates that the statistical properties of response can be expressed in multifold integral forms and its moments can be expressed in explicit forms. The response of Northrop F-5A aircraft subject to the non-Gaussian gust was formulated and the response statistics presented. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

N78-19166*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.

A PORTABLE DEVICE PARTICULARLY SUITED FOR USE IN STARTING AIR-START UNITS FOR AIRCRAFT Patent Application

William R. Rosier and George C. Volk, inventors (to NASA) Filed 9 Mar. 1978 15 p
(Contract NAS4-2272)
(NASA-Case-FRC-10113-1; US-Patent-Appl-SN-885066) Avail: NTIS HC A02/MF A01 CSCL 01E

The invention is embodied in a device including: (1) a DC circuit having a pair of terminal plugs, each plug being characterized by a first, second, and third terminal, (2) a pair of manually operable switches for connecting the first terminal of each of the plugs to the positive side of a voltage source, (3) a circuit lead connecting the second terminal of each plug to the negative side of said source, (4) a pair of electrical cables adapted to connect the first and second terminals of each plug to an air-start unit, (5) means for connecting each of the cables between the first terminal of one plug and the third terminal of the other plug of the pair, and (6) a second pair of manually operable switches for selectively connecting the third terminal of each plug of the pair to the negative side of the voltage source whereby electrical continuity of each cable of the pair may be examined prior to being connected to an air-start unit. NASA

N78-19167# Naval Air Engineering Center, Lakehurst, N.J. Test Dept.

EVALUATION OF THE CVN 68/CVN 69 LAUNCHING SYSTEM Final Report, 16 Aug. 1970 - 31 Mar. 1976

Michael A. Manganello 28 Dec. 1977 75 p refs
(AD-A049044; NAEC-94-1140) Avail: NTIS HC A04/MF A01 CSCL 13/10

This report presents the final evaluation of the Integrated Catapult Control Station and associated catapult equipment for the CVN 68/CVN 69 launching system. Evaluation testing was conducted on the TC13 Mod 1 catapult site. The report delineates the deficiencies and discrepancies found in the CVN 68/CVN 69 launching system. Implementation of the recommended changes to the deficient items would greatly improve operations and increase the reliability and maintainability of the catapults aboard the CVN 68/CVN 69 and later carriers with these innovations incorporated. Author (GRA)

N78-19168# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

ANALYSIS AND DESIGN OF A COOLED SUPERCRITICAL AIRFOIL TEST MODEL M.S. Thesis

Ray Glenn Pope, Jr. Dec. 1977 101 p refs
(AD-A048895; AFIT/GAE/AA/77D-11) Avail: NTIS HC A06/MF A01 CSCL 20/4

A wind tunnel test model of a supercritical airfoil was designed to investigate the wall cooling effect on subsonic boundary layer stability. A DSMA 523 airfoil section was employed. The model was designed to have surface temperature instrumentation and a liquid nitrogen cooling system. Heat transfer, aerodynamic loads and stresses, and instrumentation were analyzed for the proposed test conditions. A computer program was developed to analyze the forced, convective heat transfer over a two-dimensional body with a constant wall temperature. The program utilized an integral method to compute local Santon numbers. Local heat flux and total heat flow were predicted for a Mach number of 0.7, Reynolds numbers of 0.923 x 10 to the 6th power and 1.673 x 10 to the 6th power, and cooling ratios from 1.000 to 0.824. The stress analysis consisted of applying beam bending theory, along with some simplifying assumptions, to the model. Construction drawings and specified test conditions for Mach numbers of 0.3, 0.5, and 0.7 are included. The proposed tests are to be conducted in the subsonic test section of the Trisonic Test Facility at Wright-Patterson AFB, Ohio. Author (GRA)

N78-19169# Air Force Human Resources Lab., Brooks AFB, Tex.

DISPLAY AND SPEECH DEVICES FOR SIMULATOR INSTRUCTOR/OPERATOR STATION APPLICATIONS Final Report, Jun. 1975 - Jun. 1976

Noel F. Schwartz Dec. 1977 18 p refs
(AD-A049247; AFHRL-TR-77-50) Avail: NTIS HC A02/MF A01 CSCL 05/9

The Air Force Human Resources Laboratory (AFHRL) has the responsibility for research and development of advanced simulation techniques, including more efficient and more effective Instructor Operator Stations (IOS) which would possibly use newly developed display devices and techniques and speech response/recognition devices. This review was undertaken to become better acquainted with the state of the art of hardware devices which could be used for the IOS's of advanced aircraft training simulators and to provide some guidance in these devices to designers, specifiers and users of IOS's. Attention focused mainly on display devices and speech response/recognition devices. A survey of technical literature concerning display devices, and speech synthesis and speech recognition devices was accomplished and contacts were established with a number of manufacturers and developers of these devices to determine the latest developments and potential applications. Also, literature was searched for R and D related to the application of such devices. Some of the merits and shortcomings of a number of display devices (i.e., cathode ray tubes (CRT) and alternative but similar devices) are discussed and descriptions of their operation are included. Speech interaction with computers is also discussed in a similar manner. It is concluded that new display devices will not significantly impact the general design or utilization of the IOS. Advancement of speech recognition could have a significant impact, but development beyond present capabilities does not appear imminent. Author (GRA)

N78-19170# Gulf and Western Applied Science Labs., Waltham, Mass.

SENSORY MECHANISM MODELING Interim Report, 26 Jan. 1976 - 20 Jul. 1977

Joshua Borah, Laurence R. Young, and Renwick E. Curry Oct. 1977 40 p refs
(Contract F33615-76-C-0039)
(AD-A049278; AFHRL-TR-77-70) Avail: NTIS HC A03/MF A01 CSCL 06/16

The purpose of this study was to model human motion and orientation sensing mechanisms so that simulator motion cueing systems can be designed to take full advantage of the characteristics of these sensory mechanisms. Individual models for vestibular, visual, tactile, and proprioceptive sensors have been either adapted from previous modeling work or formulated from available psychophysical and neurophysiological data. A literature search was conducted to help identify material in the area of mechanoreceptor systems, and the resulting bibliography is included. A

composite model structure has been proposed, using a Kalman filter blending technique to integrate information from the different sensory modalities into a single estimate of state. The Kalman filter represents the presumed function of neural central processing. The model has been implemented in the form of a digital computer program, and promising preliminary results, in qualitative agreement with known responses, have been obtained using only vestibular model components. Ongoing work is directed at exercising the nonvestibular modalities, performing thorough validation and exercise of the entire model, and extending the model where possible. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

No abstracts in this category.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N78-19171# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
OPTIMAL ATTITUDE CONTROL OF AN ORBITING SATELLITE CONTAINING FLEXIBLE APPENDAGES M.S. Thesis
Vincent Thomas Cilmi Dec. 1977 116 p refs
(AD-A048369; AFIT/GA/AA/77D-1) Avail: NTIS HC A06/MF A01 CSCL 22/1

This thesis investigated three methods for obtaining optimal control requirements for satellites having flexible appendages. A discrete method, modal method, and a new integral coordinate method for obtaining control requirements were examined. Mathematical formulation was performed on a satellite configuration consisting of a symmetrical rigid body with two flexible antennas extending in opposite directions along the spin axis. System equations of motion were derived using Hamilton's equations. Modern optimal control theory, involving the minimization of a quadratic cost functional and the numerical solution to the steady state matrix Riccati equation, were applied to the system. The results of this thesis indicate that the integral coordinate technique provides a valid and useful means of obtaining realistic estimates of control requirements for the class of satellites under consideration. GRA

N78-19172# TRW Systems Group, Redondo Beach, Calif.
ABRES FLIGHT TEST EVALUATION OF RV ACCURACY
W. J. Burns Sep. 1974 228 p refs
(Contract F04701-73-C-0020)
(AD-A048471; TRW-23906-7114-RU-00; SAMSO-CDRL-A023) Avail: NTIS HC A11/MF A01 CSCL 16/3

Current emphasis on improved weapon system accuracy improvement may eventually require the development and flight test evaluation of an RV designed for minimum reentry dispersion. This report documents the flight test measurement requirements necessary to verify the reentry system accuracy performance including climatology, ballistic coefficient and lift effects for a minimum dispersion reentry vehicle. The study was performed parametrically for a reentry vehicle configuration with ballistic coefficients ranging from 1500 to 4000 psf over a range of reentry angles from 15 to 40 degrees. The study develops a reentry error budget which defines the magnitude of expected errors, and the most sensitive altitude regions. The results are used to establish measurement requirements including the types of measurements that must be made, the altitude region, and the accuracies of the measurements. The capabilities of off-board and on-board instrumentation to meet the measurement requirements are examined including an extensive error analysis using the metric trackers in the Kwajalein terminal area. Different methods of post-flight data processing are reviewed.
Author (GRA)

N78-19173# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
STATION KEEPING AT THE L4 LIBRATION POINT: A THREE DIMENSIONAL STUDY M.S. Thesis
George DeFilippi, Jr. Dec. 1977 117 p refs
(AD-A048965; AFIT/GA/AA/77D-3) Avail: NTIS HC A06/MF A01 CSCL 22/2

In this work, the station keeping parameters at the earth-moon libration point, L4, were studied. These equations of motion for the three-dimensional, four body system with elliptical orbits were derived. These equations were then linearized about the L4 point; and optimal control theory was applied to obtain a linear feedback controller. The major computations of the controller were associated with the gain matrix, which is the solution to the time varying Riccati equation. Because of the periodic nature of the time varying gains, it was felt that a modified (fixed gain) control could be used. The modified controller was found by computing the steady-state average of the time varying gains. Several observations were made in studying the performance of the satellite in the vicinity of the L4 point. First, it was found that the modified controller was computationally much simpler than the optimum controller while providing near optimal performance. Second, there is approximately a linear relationship, up to a point, between station keeping cost and distance from the L4 point. Third, there are initial solar configurations which minimize station keeping costs. Author (GRA)

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

No abstracts in this category.

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N78-19174* National Aeronautics and Space Administration, Washington, D. C.
NASA SATELLITE TO TRACK NORTH POLE EXPEDITION
24 Feb. 1978 8 p
(NASA-News-Release-78-29; P78-10027) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

The proposed expedition of a lone explorer and the use of Nimbus 6 (NASA meteorological research satellite) to track his journey is reported. The journey is scheduled to start March 4, 1978, and will cover a distance of 6,000 Km (3,728 miles) from northern Canada to the North Pole and return, traveling the length of Greenland's isolated interior. The mode of transportation for the explorer will be by dog sled. Instrumentation and tracking techniques are discussed. G.Y.

N78-19175*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REPORT OF THE JOINT SCIENTIFIC MISSION DEFINITION TEAM FOR AN INFRARED ASTRONOMICAL SATELLITE
May 1976 104 p
(NASA-TM-79386) Avail: NTIS HC A06/MF A01 CSCL 22B

The joint effort is reported of scientists and engineers from

the Netherlands, the United Kingdom, and the United States working as a team for the purpose of exploring the possibility of a cooperative venture. The proposed mission builds upon experience gained from the successful Astronomical Netherlands Satellite (ANS). This satellite will be in a polar orbit at an altitude of 900 km. It will carry an 0.6 m diameter telescope cooled with helium to a temperature near 10K. An array of approximately 100 detectors will be used to measure the infrared flux in four wavelength bands centered at 10, 20, 50, and 100 microns. Sources will be located on the sky with positional accuracy of 0.5 arcminute. The instrument should be able to investigate the structure of extended sources with angular scales up to 1.0 deg. The entire sky will be surveyed and the full lifetime of the mission of about one year will be necessary to complete the survey. Special observational programs will also be incorporated into the mission. Author

N78-19176*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AMBIGUITY RESOLUTION FOR SATELLITE DOPPLER POSITIONING SYSTEMS

P. Argentiero and J. Marini Dec. 1977 30 p refs Submitted for publication

(NASA-TM-78049) Avail: NTIS HC A03/MF A01 CSCL 22A

A test for ambiguity resolution was derived which was the most powerful in the sense that it maximized the probability of a correct decision. When systematic error sources were properly included in the least squares reduction process to yield an optimal solution, the test reduced to choosing the solution which provided the smaller valuation of the least squares loss function. When systematic error sources were ignored in the least squares reduction, the most powerful test was a quadratic form comparison with the weighting matrix of the quadratic form obtained by computing the pseudo-inverse of a reduced rank square matrix. A formula is presented for computing the power of the most powerful test. A numerical example is included in which the power of the test is computed for a situation which may occur during an actual satellite aided search and rescue mission. Author

N78-19177# National Aerospace Lab., Tokyo (Japan).

PRELIMINARY TRAJECTORY ANALYSIS FOR THE LOWEST-FLYING EARTH SATELLITE, DAS

Koji Otsubo, Tomifumi Godai, and Hideo Nagasu Jul. 1977 43 p refs In JAPANESE; ENGLISH summary

(NAL-TR-507) Avail: NTIS HC A03/MF A01

The trajectory of the lowest flying earth satellite, DAS, was analyzed by the step-by-step integration procedure of nonlinear differential equations of satellite motion assuming the modified Jacchia atmospheric model and the drag coefficient of a sphere in a rarefied hypersonic flow. The purpose of the DAS flying at the very low altitude around 100 km is to explore the bottomside of the ionosphere. Because of low deceleration caused by drag above 100 km altitude, only a small acceleration by an on-board propulsion system is required to defeat drag and restore elliptic orbit decay. The two cases of impulsive thrust and powered flight at constant thrust are discussed. Author

N78-19178# Aerospace Corp., El Segundo, Calif.

CLOSED FORM MAGNETIC QUARTER ORBIT SWITCH POINT SOLUTION

L. K. Herman Jul. 1977 13 p refs

(Contract F04701-76-C-0077)

(AD-A048624; TR-0077(2506-16)-1; SAMSO-TR-77-214) Avail: NTIS HC A02/MF A01 CSCL 22/2

A closed form solution is derived for determining the location of a set of magnetic switch points, spaced 90 deg apart in the orbit, which will allow the spin axis of a satellite to be moved in any, achievable, desired direction from any initial orientation. Additional closed form equations are derived for determining the magnitude of the motion that will result for a given set of switch points. The simplicity of the calculations makes the technique extremely useful for applications where savings in computer time or storage are desired and for design studies where quick solutions to many cases are required. Author (GRA)

N78-19179# National Range Operations Directorate, White Sands Missile Range, N. Mex. Analysis and Computation Div.

STATE SPACE TECHNIQUES IN APPROXIMATION THEORY WITH APPLICATION TO DESIGN OF RECURSIVE OPTIMAL ESTIMATORS, VOLUME 1

James S. Pappas Sep. 1977 430 p refs

(AD-A048718; ACD-63-77-Vol-1) Avail: NTIS HC A19/MF A01 CSCL 16/2

In many applications of recursive estimation theory to trajectory estimation the process dynamics are not used. In these cases one normally resorts to approximating the forces with fitting functions. Polynomials, exponentially weighted polynomials and trigonometric and their orthogonal counterparts Gram, Legendre, and Laguerre polynomials are developed in a vector space setting. Matrices describing the connections between the bases and their velocity matrices and their pseudo-inverses are developed. Continuous and discrete function filtering dynamics are presented. These relations can serve as an aid to fitting functions filter design. Author (GRA)

N78-19180# National Range Operations Directorate, White Sands Missile Range, N. Mex. Analysis and Computation Div.

STATE SPACE TECHNIQUES IN APPROXIMATION THEORY WITH APPLICATIONS TO DESIGN OF RECURSIVE OPTICAL ESTIMATORS, VOLUME 2

James S. Pappas Sep. 1977 425 p refs

(AD-A048719; ACD-63-77-Vol-2) Avail: NTIS HC A18/MF A01 CSCL 16/2

This text exemplifies the theory presented in volume one with many examples. GRA

N78-19181# Brown Univ., Providence, R. I. Div. of Engineering.

CONTROL LAW FOR A MISSILE INTERCEPT SYSTEM Interim Report

K. C. Wei and A. E. Pearson Nov. 1977 26 p refs

(Grant AF-AFOSR-2793-75)

(AD-A049329; AFOSR-78-0022TR) Avail: NTIS HC A03/MF A01 CSCL 15/3

A feedback control law is derived for a two dimensional missile intercept system which combines in a step-by-step manner the closed form solutions to a least squares estimation of the target turn rate, line speed and heading with a minimum control energy problem subject to a terminal intercept constraint. The major assumptions are that the pursuer possesses thrust modulation capabilities, in addition to thrust vectoring, and that continuous measurements of the range coordinates are available for estimation purposes. Simulation results are included which indicate that good terminal accuracy is achieved when the estimation errors are small and illustrate the limitations on accuracy when fluctuations occur in the target speed and turn rate. Author (GRA)

N78-19182# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

EXPERIMENTAL INVESTIGATIONS AT MACH 0.8 OF THE STABILITY AND CONTROL CHARACTERISTICS OF MISSILE CONFIGURATIONS WITH WRAPAROUND SURFACES

E. F. Lucero Aug. 1977 84 p refs

(Contract N00017-72-C-4401)

(AD-A048849; APL/JHU-TG-1312) Avail: NTIS HC A05/MF A01 CSCL 16/4

The aerodynamic feasibility of using wraparound lifting, stabilizing, and controlling surfaces on tube-launched bank-to-turn missile configurations is established by wind tunnel tests at high subsonic speeds. Test results show that the stability and control characteristics of a wraparound-surface configuration are as good or better than those of an equivalent planar-surface configuration. Predictions based on planar surfaces agree well with test results when surface-to-surface interference is not present. An improved prediction method for tail efficiency of wraparound-surface configurations is shown. Several configurational design preferences are indicated by the test results, including high wings with concave side windward, horizontal tails mounted with their concave side windward when in the undeflected position, and a windward directional stabilizer. Author (GRA)

N78-19183# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

ATTITUDE DETERMINATION OF TRIAD AND TIP-2 AND 3 GRAVITY-GRADIENT-STABILIZED SATELLITES
C. E. Williams Dec. 1977 62 p refs
(Contract N00017-72-C-4401)
(AD-A048850; APL/JHU-TG-1313) Avail: NTIS HC A04/MF A01 CSCL 22/1

The attitude of a satellite refers to the rotational orientation of the spacecraft relative to some reference triad of Cartesian axes (these being, for the type of spacecraft treated here, the orbit radius vector, the normal-to-the-orbit plane, and the vector cross product of the two). Mathematically, the attitude is usually represented by nine direction cosines and/or three Euler angles. The numerical determination of these parameters is the objective of attitude estimation. Various schemes have been developed and used by the Applied Physical Laboratory to determine the attitude performance of its satellites. In recent years, a least-squares technique that involves eigenvalue and eigenvector computation has been added. This report presents the formulation of the technique and discusses its successful application. Attitude estimation results from three orbiting spacecraft are included.
Author (GRA)

N78-19184 Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE MIT LINCOLN LABORATORY PULSED PLASMA THRUSTER Final Report
Robert J. Vondra 14 Nov. 1976 9 p refs Presented at the AIAA Intern. Elec. Propulsion Conf., paper no. 76-998, Key Biscayne, Fla., 14-17 Nov. 1976
(Contract F19628-76-C-0002; AF Proj. 649L)
(AD-A049013; MS-4273; ESD-TR-76-387) Copyright. Avail: Issuing Activity CSCL 20/9

This report discusses the development program for the LES-8/9 flight pulsed plasma thrusters (PPT's); in particular: (1) the testing of PPT electronic components, (2) the changes made in the electronic circuitry as a consequence of thruster operation, (3) the testing of flight PPT's, and (4) the integration of PPT's to the LES-8/9 satellite. As a result of a series of problems in the PPT electronics the thrusters were eventually replaced on LES-8/9 by a cold ammonia gas system. Work continued, however, and ultimately the PPT system was proven flightworthy by successfully completing the thruster ground test program.
GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

N78-19185* National Aeronautics and Space Administration, Washington, D. C.
SHUTTLE BEING TESTED AT MARSHALL CENTER
Mar. 1978 20 p
(NASA-News-Release-78-47; P78-10045) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22B

Ground vibration tests of the space shuttle vehicle performed to evaluate the structural dynamics and their effect on the control system of the shuttle are described. Test results are used to verify the system design and mathematical models that predict how the shuttle's control system will react to the much more severe vibrations expected during launch and flight into orbit. The test configurations, the test facility, and the dynamic test suspension system are among the topics discussed.
J.M.S.

N78-19186*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE POWER SYSTEMS TECHNOLOGY ENABLEMENT STUDY
L. D. Smith and J. W. Stearns 15 Feb. 1978 135 p refs
(Contract NAS7-100)
(NASA-CR-155804; JPL-Pub-78-7) Avail: NTIS HC A07/MF A01 CSCL 22A

The power system technologies which enable or enhance future space missions requiring a few kilowatts or less and using the space shuttle were assessed. The advances in space power systems necessary for supporting the capabilities of the space transportation system were systematically determined and benefit/cost/risk analyses were used to identify high payoff technologies and technological priorities. The missions that are enhanced by each development are discussed.
Author

N78-19187*# General Electric Co., Philadelphia, Pa. Space Div.
INVESTIGATION OF A SPACE DELTA TECHNOLOGY FACILITY (SDTF) FOR SPACELAB Final Report
J. D. Welch Dec. 1977 234 p
(Contract NAS5-23858)
(NASA-CR-156691; Doc-77SDS4267) Avail: NTIS HC A11/MF A01 CSCL 22B

The Space Data Technology Facility (SDTF) would have the role of supporting a wide range of data technology related demonstrations which might be performed on Spacelab. The SDTF design is incorporated primarily in one single width standardized Spacelab rack. It consists of various display, control and data handling components together with interfaces with the demonstration-specific equipment and Spacelab. To arrive at this design a wide range of data related technologies and potential demonstrations were also investigated. One demonstration concerned with online image rectification and registration was developed in some depth.
Author

N78-19188*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
MISSION FEASIBILITY STUDY OF A VERY LONG BASELINE INTERFEROMETER UTILIZING THE SPACE SHUTTLE Final Report
Bernard F. Burke Feb. 1978 77 p refs
(Grant NsG-5150)
(NASA-CR-155938) Avail: NTIS HC A05/MF A01 CSCL 22A

An introductory overview of very long baseline interferometry (VLBI) as it exists and is used today is given and the scientific advances that have been achieved with this technique in the past decade are described. The report briefly reviews developments now in progress that will improve ground station VLBI in the next few years, and the limitations that still will exist. The advantages and the scientific return on investment that may be expected from a VLBI terminal in space are described. Practical problems that have to be faced range from system design through hardware implementation, to data recovery and analysis.
Author

N78-19189*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE SHUTTLE ORBITER APPROACH AND LANDING TEST Final Report
Feb. 1978 203 p refs
(NASA-TM-79404; JSC-13864) Avail: NTIS HC A10/MF A01 CSCL 01C

The Approach and Landing Test Program consisted of a series of steps leading to the demonstration of the capability of the Space Shuttle orbiter to safely approach and land under conditions similar to those planned for the final phases of an orbital flight. The tests were conducted with the orbiter mounted on top of a specially modified carrier aircraft. The first step provided airworthiness and performance verification of the carrier aircraft after modification. The second step consisted of three taxi tests and five flight tests with an inert unmanned orbiter. The third step consisted of three mated tests with an active manned orbiter. The fourth step consisted of five flights in which the orbiter was separated from the carrier aircraft. For the final two flights, the orbiter tail cone was replaced by dummy engines to simulate the actual orbital configuration. Landing gear braking and steering tests were accomplished during rollouts following the free flight landings. Ferry testing was integrated into the Approach and Landing Test Program to the extent possible. In addition, four ferry test flights were conducted with the orbiter mated to the carrier aircraft in the ferry configuration after the free-flight tests were completed.
Author

N78-19190*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
VIBRATION EFFECTS OF THE SPACE SHUTTLE MAIN ENGINE HIGH PRESSURE OXIDIZER TURBOPUMP BELLOWS

James A. Harp Feb. 1978 56 p
(NASA-TM-78157) Avail: NTIS HC A04/MF A01 CSCL 21H

A welded metal bellows was subjected to a series of vibration tests in a 400 psi oxygen environment to evaluate the effects of the bellows convolutes rubbing on the damper ring in the high pressure oxidizer turbopump of the space shuttle main engine. The bellows was subjected to approximately 2 million cycles at 0.007 in. double amplitude displacement during this series of tests, at a frequency of 400 Hz. Intrumentation of the test specimen revealed no significant heat buildup caused by the rubbing of the bellows convolutes on the damper ring. A final destruct test was made to determine if a fire would result if the bellows ruptured in the 400 psi oxygen environment, thus exposing a fresh metal surface. The vibration input was changed to 0.8 in. double amplitude displacement at 20 Hz to intentionally rupture the bellows. Failure occurred after 2.5 sec; no fire or heat buildup was encountered. Author

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

N78-19191# Naval Surface Weapons Center, Dahlgren, Va.
SEGMENTED LEAST-SQUARES SOLUTION FOR BIASES, BIAS RATES AND HIGHER-ORDER TERMS OF INTERSECTING ALTIMETRY TRACKS
Peter Ugincius Nov. 1977 34 p refs
(AD-A048905; NSWC/DL-TR-3721) Avail: NTIS HC A03/MF A01 CSCL 17/7

A segmented least-squares algorithm is presented which solves for biases, bias rates, and higher-order terms of intersecting satellite altimetry tracks. Input data are geoid-height differences at the intersections. Step-by-step instructions for coding this algorithm are provided in an appendix. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

No abstracts in this category.

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N78-19192*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY DESIGN FOR A STANDARD 10 SUP 7 BIT SOLID STATE MEMORY (SSM)
P. J. Hayes, W. M. Howle, Jr., and R. L. Stermer, Jr. Feb. 1978 58 p refs
(NASA-TM-78674) Avail: NTIS HC A04/MF A01 CSCL 22B

A modular concept with three separate modules roughly separating bubble domain technology, control logic technology, and power supply technology was employed. These modules were respectively the standard memory module (SMM), the data control unit (DCU), and power supply module (PSM). The storage medium was provided by bubble domain chips organized into memory cells. These cells and the circuitry for parallel data access to the cells make up the SMM. The DCU provides a flexible serial data interface to the SMM. The PSM provides adequate power to enable one DCU and one SMM to operate simultaneously at the maximum data rate. The SSM was designed to handle asynchronous data rates from dc to 1.024 Mbs with a bit error rate less than 1 error in 10 to the eight power bits. Two versions of the SSM, a serial data memory and a dual parallel data memory were specified using the standard modules. The SSM specification includes requirements for radiation hardness, temperature and mechanical environments, dc magnetic field emission and susceptibility, electromagnetic compatibility, and reliability. Author

N78-19193*# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
USER'S GUIDE TO DATA OBTAINED BY THE AEROSPACE CORPORATION ENERGETIC PARTICLE SPECTROMETER ON ATS-6
G. A. Paulikas and H. H. Hilton 3 Oct. 1977 120 p refs
(Contract NAS5-23788)
(NASA-CR-155950; ATR-78(7642)-1) Avail: NTIS HC A06/MF A01 CSCL 14B

Descriptions of the energetic particle detector are offered with calibration data, as part of a user's guide to the data obtained by ATS 6. Information on instrumental and operational anomalies and a description of the procedures used to reduce the data are also presented along with a description of the format of the data. Author

N78-19194*# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
REDUCTION AND ANALYSIS OF ATS-6 DATA Final Report, 1 Nov. 1976 - 31 Oct. 1977
G. A. Paulikas and J. B. Blake 10 Nov. 1977 82 p refs
(Contract NAS5-23788)
(NASA-CR-155951; ATR-78(7642)-2) Avail: NTIS HC A05/MF A01 CSCL 14B

Results obtained from the analysis of data returned by the energetic particle spectrometer on ATS 6 are presented. The study of the energetic electron environment and the effects of the solar wind parameters on the energetic electrons trapped at the synchronous altitude are emphasized. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N78-19195*# Hughes Research Labs., Malibu, Calif. Ion Physics Dept. Staff.
EXTENDED PERFORMANCE SOLAR ELECTRIC PROPULSION THRUST SYSTEM STUDY. VOLUME 5: CAPACITOR-DIODE VOLTAGE MULTIPLIER: TECHNOLOGY EVALUATION Final Report
R. M. Martinelli Sep. 1977 74 p
(Contract NAS3-20395)
(NASA-CR-135281-Vol-5) Avail: NTIS HC A04/MF A01 CSCL 21C

A 1-kW capacitor-diode voltage multiplier (CDVM) was designed, fabricated and tested to demonstrate the power of feasibility of high power CDVM's and to verify the analytical techniques that had been used to predict the performance characteristics of a 6-kw CDVM. High efficiency (96.2%), a low ratio of component weight to power (0.55 kg/kW), and low

output ripple voltage (less than 1%, peak to peak) were obtained during the operation of a 1-kW CDVM various input line, load current, and load fault conditions. Author

N78-19196*# Hughes Research Labs., Malibu, Calif.
EXTENDED PERFORMANCE SOLAR ELECTRIC PROPULSION THRUST SYSTEM STUDY. VOLUME 3: TRADEOFF STUDIES OF ALTERNATE THRUST SYSTEM CONFIGURATIONS Final Report, 14 Feb. - 29 Aug. 1977
E. I. Hawthorne Dec. 1977 157 p refs
(Contract NAS3-20395)
(NASA-CR-135281-Vol-3) Avail: NTIS HC A08/MF A01 CSCL 21C

Several thrust system design concepts were evaluated and compared using the specifications of the most advanced 30 cm engineering model thruster as the technology base. Emphasis was placed on relatively high power missions. The extensions in thruster performance required for the Halley's comet mission were defined and alternative thrust system concepts were designed in sufficient detail for comparing mass, efficiency, reliability, structure, and thermal characteristics. Confirmation testing and analysis of thruster and power-processing components were performed. A baseline design was selected from the alternatives considered, and the design analysis and documentation were refined. A program development plan was formulated that outlines the work structure considered necessary for developing, qualifying, and fabricating the flight hardware for the baseline thrust system within the time frame of a project to rendezvous with Halley's comet. An assessment was made of the costs and risks associated with a baseline thrust system as provided to the mission project under this plan. Critical procurements and interfaces were identified and defined. Author

N78-19197*# National Aeronautics and Space Administration, Washington, D. C.
MANUFACTURE OF IONIZERS INTENDED FOR ELECTRIC PROPULSION
Andre Hivert and Jean Labbe Mar. 1978 15 p refs Transl. into ENGLISH of Conf. paper from ONERA, Paris, ONERA-TP-1977-36 Presented at Seminaire Plansee de Re Metallica, 9th Reutte, Austria, 23-26 May 1977 Original language document was announced as A77-50978 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75280; ONERA-TP-1977-36) Avail: NTIS HC A02/MF A01 CSCL 21C

An electric propulsion system which relies on the formation of cesium ions in contact with a porous wall made of a metal with a high work function when the wall is heated to 1500 K was described. The manufacture of porous walls on the mountings was considered. Erosion of the electrodes by slow ions was examined, and the life times of the ionizers was estimated by means of experimental studies. The purpose of the electric propulsion system was to bring about minor corrections in the orbits of geostationary satellites; the main advantage of this system was that it weighs less than currently used hydrazine systems. Author

N78-19198*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
INERT GAS THRUSTERS Annual Report, 1 Aug. 1976 - 30 Jul. 1977
Harold R. Kaufman Jul. 1977 78 p refs
(Grant NsG-3011)
(NASA-CR-135226) Avail: NTIS HC A05/MF A01 CSCL 21C

Inert gases, particularly argon and xenon, are of interest as possible alternatives to the usual electric thruster propellants of mercury and cesium. Hollow cathode data were obtained for a wide range of operating conditions. Some test conditions gave plasma coupling voltages at or below the sputtering threshold, hence should permit long operating lifetimes. All observations of hollow cathode operation were consistent with a single theory of operation, in which a significant amount of the total electron emission is from localized areas within the orifice. This mode of emission is also supported by scanning electron microscope photographs that indicate local temperatures at or near the melting temperature of the tungsten tip. Experimental hollow cathode performance was correlated for two orifice diameters, three inert gas propellants, and a range of flow rates for each propellant. The basic theory for the production of doubly ionized argon and xenon was completed. Experimental measurements of the doubly ionized fraction agree with theory within about plus or minus 20 percent. High voltage isolators were studied for the propellant feed line. The breakdown voltage per segment ranged from 300 to over 500 V with argon. Author

N78-19199*# Auburn Univ., Ala. School of Engineering.
SOLID PROPELLANT ROCKET MOTOR INTERNAL BALLISTICS PERFORMANCE VARIATION ANALYSIS, PHASE 3 Final Report
Richard H. Sforzini, Winfred A. Foster, Jr., Jesse E. Murph, and G. Wade Adams, Jr. Nov. 1977 87 p refs
(NCA8-00120; NCA8-00124)
(NASA-CR-150577) Avail: NTIS HC A05/MF A01 CSCL 21H

Results of research aimed at improving the predictability of off nominal internal ballistics performance of solid propellant rocket motors (SRMs) including thrust imbalance between two SRMs firing in parallel are reported. The potential effects of nozzle throat erosion on internal ballistic performance were studied and a propellant burning rate low postulated. The propellant burning rate model when coupled with the grain deformation model permits an excellent match between theoretical results and test data for the Titan IIIC, TU455.02, and the first Space Shuttle SRM (DM-1). Analysis of star grain deformation using an experimental model and a finite element model shows the star grain deformation effects for the Space Shuttle to be small in comparison to those of the circular perforated grain. An alternative technique was developed for predicting thrust imbalance without recourse to the Monte Carlo computer program. A scaling relationship used to relate theoretical results to test results may be applied to the alternative technique of predicting thrust imbalance or to the Monte Carlo evaluation. Extended investigation into the effect of strain rate on propellant burning rate leads to the conclusion that the thermoelastic effect is generally negligible for both steadily increasing pressure loads and oscillatory loads. Author

N78-19200*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
ELECTRIC PROTOTYPE POWER PROCESSOR FOR A 30CM ION THRUSTER Final Report, 1 Apr. 1975 - 1 Mar. 1977
J. J. Biess, L. Y. Inouye, and A. D. Schoenfeld Mar. 1977 104 p
(Contract NAS3-19730)
(NASA-CR-135287; TRW-28014-6001-TU-00) Avail: NTIS HC A06/MF A01 CSCL 21C

An electrical prototype power processor unit was designed, fabricated and tested with a 30 cm mercury ion engine for primary space propulsion. The power processor unit used the thyristor series resonant inverter as the basic power stage for the high power beam and discharge supplies. A transistorized series resonant inverter processed the remaining power for the low power outputs. The power processor included a digital interface unit to process all input commands and internal telemetry signals so that electric propulsion systems could be operated with a central computer system. The electrical prototype unit included design improvement in the power components such as thyristors, transistors, filters and resonant capacitors, and power transformers and inductors in order to reduce component weight, to minimize losses, and to control the component temperature rise. A design analysis for the electrical prototype is also presented on the component weight, losses, part count and reliability estimate. The electrical prototype was tested in a thermal vacuum environment. Integration tests were performed with a 30 cm ion engine and demonstrated operational compatibility. Electromagnetic interference data was also recorded on the design to provide information for spacecraft integration. Author

N78-19201# Ogden Air Logistics Center, Hill AFB, Utah. Propellant Lab. Section.
PROPELLANT SURVEILLANCE REPORT LGM-30A, B, F AND G STAGE 1: TP-H1043 AFT CLOSURE PROPELLANT Semiannual Report
John A. Thompson Dec. 1977 33 p
(AD-A048819; MANCP-385(77)) Avail: NTIS MF A01 CSCL 21/9

This report contains propellant test results from cartons of TP-H1043 propellant representing selected batches used in the aft closure of First Stage-Minuteman Motors. Data from TP-H1043 propellant obtained from the aft closures of the LGM-30A, B, F and G Motors are reported in regression analyses for the fourth time and the third time using the GO-85 computer system. An analysis of all parameters indicates that no significant degradation is anticipated for at least two years past the oldest data point. Each point on the regression plot represents all samples at the particular age. The number of samples at each point is indicated on the sample size summary sheet on the page accompanying each regression plot. The data range at any age can be found by suitable inquiry of the GO-85 system. GRA

N78-19202# Pennsylvania State Univ., University Park.
TRANSIENT COMBUSTION IN SOLID PROPELLANT CRACKS Progress Report, Jan. - Dec. 1976
K. K. Kuo, A. T. Chen, D. R. McClure, and F. G. Lucas China Lake, Calif. Naval Weapons Center Oct. 1977 47 p refs
(Contract N60530-76-C-0138)
(AD-A048978; NWC-TP-5943) Avail: NTIS HC A03/MF A01 CSCL 21/9

A one-dimensional theoretical model, incorporating the Noble-Abel dense gas law, has been developed to describe the transient model combustion phenomena inside a propellant crack. The theoretical model can be used to predict wave phenomena, heat transfer from the gas to the propellant surface and associated thermal penetration, flame propagation, and resultant pressurization at various locations along the propellant cavity. Calculations made with the current theoretical model revealed that the internal pressurization rate, pressure gradient, and flame velocity in propellant cracks (for which gases can penetrate) decrease as: the gap width increases, the rocket chamber pressurization rate decreases, and the propellant gasification temperature increases. Additionally, the predicted flame spreading was found to decelerate in a region near the crack tip; this phenomena has been experimentally observed by others. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes laminates.

N78-19203 Pittsburgh Univ., Pa.
THE STRUCTURE, THERMAL MOTION AND VALENCE CHARGE DENSITY OF GRAPHITE Ph.D. Thesis
Ruey-Hong Chen 1977 149 p
Avail: Univ. Microfilms Order No. 7723566

Small, natural, single crystals of graphite were studied using X ray and neutron diffraction. Each atom was assumed to have an unperturbed 1s shell, and the valence charge about each carbon atom was expanded in multipoles up to seventh order. The results of the refinements indicate a qualitative description of the valence charge denisty. The analysis is consistent with strong covalent bonds within the basal planes and with weak interactions between the layers. Comparisons between the graphite results and similar studies of diamond and beryllium give further evidence of generalized X ray scattering factors' ability to extract significant information about bonding in crystals.
Dissert. Abstr.

N78-19204*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AXIAL RESIDUAL STRESSES IN BORON FIBERS
Donald R. Behrendt 1978 19 p refs Presented at 2d Intern. Conf. on Composite Materials, Toronto, Canada, 16-20 Apr. 1978
(NASA-TM-73894) Avail: NTIS HC A02/MF A01 CSCL 11D

The axial residual stress distribution as a function of radius was determined from the fiber surface to the core including the average residual stress in the core. Such measurements on boron on tungsten (B/W) fibers show that the residual stresses for 102, 142, 203, and 366 micron diameter fibers were similar, being compressive at the surface and changing monotonically to a region of tensile within the boron. At approximately 25 percent of the original radius, the stress reaches a maximum tensile stress of about 860 mn/sq.m and then decreases to a compressive stress near the tungsten boride core. Data were presented for 203 micron diameter B/W fibers that show annealing above 900 C reduces the residual stresses. A comparison between 102 micron diameter B/W and boron on carbon (b/C) shows that the residual stresses were similar in the outer regions of the fibers, but that large differences near and in the core were observed. The effects of these residual stresses on the fracture of boron fibers were discussed. Author

N78-19205*# Lockheed-California Co., Burbank.
STUDY OF LOW-COST FABRICATION METHODS FOR AEROSPACE COMPOSITE MATERIALS Final Report, 6 Jan. - 30 Sep. 1977
Harvey H. Chung Jan. 1978 27 p
(Contract NAS1-14730)
(NASA-CR-145330; LR-28308) Avail: NTIS HC A03/MF A01 CSCL 11D

Flat and hat section specimens of graphite/epoxy composite materials have been fabricated by the resin bath or wet pultrusion process. This demonstrated the feasibility of incorporating crossplied graphite fiber reinforcements in conjunction with epoxy resin systems in the wet pultrusion process. However, the thickness constraints of the pultrusion process, the lack of dimensional stability of the crossply materials and equipment limitations affect the quality of the hat section pultrusions. The wet pultrusion process shows promise of being a low cost method for producing composite parts with constant cross section along the length. A cost analysis showed at least 80 percent cost reduction for the hat section and 40 percent for flat panel by pultrusion over the conventional manual and automated lay-up. Author

N78-19206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESIDUAL STRESSES IN ANGLEPLIED LAMINATES AND THEIR EFFECTS ON LAMINATE BEHAVIOR
C. C. Chamis 1978 24 p refs Presented at the 2d Intern. Conf. on Composite Mater., Toronto, 16-23 Apr. 1978
(NASA-TM-78835) Avail: NTIS HC A02/MF A01 CSCL 11D

Evidence of the presence of lamination residual stresses in angleplied laminates were transply cracks and warpage of unsymmetric laminates which occur prior to application of any mechanical load. Lamination residual strains were measured using the embedded strain gage technique. These strains result from the temperature differences between cure and room temperature and vary linearly within this temperature range. Lamination residual stresses were usually present in angleplied fiber composites laminates; they were also present in unidirectional hybrids and superhybrids. For specific applications, the magnitudes of lamination residual stresses were determined and evaluated relative to the anticipated applied stresses. Particular attention was given to cyclic thermal loadings in applications where the thermal cycling takes place over a wide temperature range.
Author

N78-19207*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL STUDY OF THE EFFECTS OF WATER REPELLANT TREATMENT ON THE ACOUSTIC PROPERTIES OF KEVLAR
C. D. Smith (Old Dominion Univ. Res. Found., Norfolk, Va.) and T. L. Parrott Jan. 1978 21 p refs
(NASA-TM-78654) Avail: NTIS HC A02/MF A01 CSCL 11D

The treatment consisted of immersing samples of Kevlar in a solution of distilled water and Zepel. The samples were then drained, dried in a circulating oven, and cured. Flow resistance

tests showed approximately one percent decrease in flow resistance of the samples. Also there was a density increase of about three percent. It was found that the treatment caused a change in the texture of the samples. There were significant changes in the acoustic properties of the treated Kevlar over the frequency range 0.5 to 3.5 kHz. In general it was found that the propagation constant and characteristic impedance increased with increasing frequency. The real and imaginary components of the propagation constant for the treated Kevlar exhibited a decrease of 8 to 12 percent relative to that for the untreated Kevlar at the higher frequencies. The magnitude of the reactance component of the characteristic impedance decreased by about 40 percent at the higher frequencies. Author

N78-19208# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A GENERAL STUDY OF HYBRID COMPOSITE LAMINATES M.S. Thesis

George D. Brooks Dec. 1977 65 p refs
(AD-A048364; AFIT/GAE/AA/77D-2) Avail: NTIS HC A04/MF A01 CSCL 11/4

This thesis is a general study of hybrid composite laminates that includes application of a three dimensional stress analysis approximation technique based on equilibrium considerations and free edge effects. Thermal residual stresses and effects of replacing lamina in a composite laminate with lamina composed of hybrid material were investigated. Two types of 48 ply hybrid composite laminates were tested under tensile and flexure loading. Results achieved experimentally for the moduli of elasticity were compared with values predicted by laminated plate theory and laminated beam theory. Thermal residual stresses proved to be significant and worthy of due consideration in stress analysis of test specimens. Hybridization, as studied, appeared to have little effect on the overall properties of a laminate. Hybrid composite laminates obey classical laminate theory and can, in certain ply configurations, develop considerable free edge effect stresses.
Author (GRA)

N78-19209# Forest Products Lab., Madison, Wis.

STRUCTURAL FEASIBILITY OF PARALLEL-LAMINATED VENEER CROSSARMS

John Youngquist, Frank Brey, and Joseph Jung 1977 18 p
(AD-A048278; FSRP-FPL-303) Avail: NTIS HC A02/MF A01 CSCL 11/12

Experimentally and commercially produced laminated M-19 crossarms were tested by standard Rural Electrification Administration (REA) crossarm tests. The laminated crossarms, produced by laminating veneer and by laminating solid-sawn dimension stock, generally performed satisfactorily according to REA specified standards. Materials tested are described and results on standarized tests are summarized. The objective of this work was to provide indications of performance trends. Statistically valid performance comparisons between the materials tested were not possible because of the limited number of samples tested.
Author (GRA)

N78-19210# Air Force Materials Lab., Wright-Patterson AFB, Ohio.

FREE EDGE STRESS FIELDS IN COMPOSITE LAMINATES Interim Report, 1 Apr. 1976 - 1 Apr. 1977

N. J. Pagano Aug. 1977 18 p refs
(AD-A049046; AFML-TR-77-113) Avail: NTIS HC A02/MF A01 CSCL 11/4

A new theory to predict stress fields within composite laminates is employed to solve the free edge class of boundary value problems. In this theory, the stress field determination reduces to the solution of a one-dimensional problem which is solved by classical methods of ordinary differential equations. No singularities are present in the new theory. Author (GRA)

N78-19211# Air Force Materials Lab., Wright-Patterson AFB, Ohio.

MOISTURE EFFECTS IN EPOXY MATRIX COMPOSITES Interim Report, 1 Dec. 1975 - Jul. 1976

C. E. Browning, C. E. Husman, and J. M. Whitney May 1977 36 p refs
(AD-A049045; AFML-TR-77-17) Avail: NTIS HC A03/MF A01 CSCL 11/4

The effect of absorbed moisture on the mechanical properties of a neat epoxy resin and derived graphite/epoxy composites is investigated. Glass transition temperature and modulus as a function of moisture content and temperature is determined for both the neat resin and composite. In addition, elastic modulus for the neat resin, and strength and elastic moduli for unidirectional composites and quasi-isotropic laminates are determined as a function of absorbed moisture and temperature. A method for predicting moisture content and through-the-thickness profile for a laminate exposed to a constant humidity and temperature is discussed. Particular attention is also given to the details of environmental testing. Data indicates that absorbed moisture and temperature effects on the neat resin translate directly to matrix dominated properties of the composite and can lead to a change in failure mode, while filament dominated properties show very little environmental sensitivity. Results also indicate that resin glass transition temperature is a function of processing as well absorbed moisture. Author (GRA)

N78-19212# Naval Research Lab., Washington, D. C. Composite Materials Branch.

SHARP NOTCH STRESS CORROSION CRACKING OF B/Al AND G/Al COMPOSITES Interim Report

W. L. Phillips Oct. 1977 22 p refs
(AD-A049058; NRL-MR-3616) Avail: NTIS HC A02/MF A01 CSCL 11/6

Sharp notch stress corrosion properties of transverse loaded, uniaxially aligned B/6061-T6 Al, B/6061-F Al, B/2024-F Al and G/201 Al/2024 Al composites have been evaluated in a salt water environment and in laboratory air. For both environments, delayed time fractures were observed in those B/Al specimens that were dead weight loaded to stress intensities greater than approximately 80% of the overload fracture toughness. Fractures did not occur, within the 1000 hour time limit, for specimens subjected to lower stress intensities. Based on comparisons of the data for salt water and air exposures, analyses of the crack- opening-displacement versus time data, and appearances of the fracture surfaces, it is concluded that the delayed time failures in B/Al were caused by room temperature creep. For the G/Al composite, load carrying capacity was reduced about 25% due to 1000 hour immersion in salt water. Delayed time failures were attributed to the combined effects of room temperature creep and pitting corrosion adjacent to the crack tip. Author (GRA)

N78-19213# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A NUMERICAL ANALYSIS OF FRACTURE IN A LAMINATED FIBROUS COMPOSITE PLATE M.S. Thesis

William Paxton Witt, III Dec. 1977 97 p refs
(AD-A048907; AFIT/GA/AA/77D-9) Avail: NTIS HC A05/MF A01 CSCL 11/4

A crack in a laminated, composite plate was modelled using numerical methods. The experimental results used to validate this analysis were for a (0, or - 45,90) graphite/epoxy plate with a center notch oriented normal to the loading direction. Two, two-dimensional finite element models were used to determine the size of the crack tip damage zones. One involved a purely elastic analysis, and in the other, the element ply stiffness was completely discounted if the stresses exceeded the Tsai-Hill failure criterion. Damage zone diagrams showing the growth and shape of the ply damage zones at increasing load levels were developed for both models. The size of the subcracks in each ply were linearly related to the opening mode stress intensity factor, K sub I, and to the strain energy release rate, G. A critical stress intensity factor approach, an instability approach, and a new fracture load prediction method based on load versus load bearing area diagrams were used to predict the fracture load. Since this new method provided close upper and lower bounds on the fracture load and is applicable to complicated structures, it was considered the best of the three methods.
Author (GRA)

N78-19214# Deposits and Composites, Inc., Herndon, Va.

ORIGINS AND CONTROL OF RESIDUAL STRESSES IN ATOMICALLY DEPOSITED MATERIALS Final Report, 1 Apr. 1976 - 31 Mar. 1977

Richard E. Engdahl 29 Nov. 1977 10 p refs

(Contract DAAG29-76-C-0030)
(AD-A049195; DCI-F-137; ARO-13464.1-MSX) Avail: NTIS HC A02/MF A01 CSCL 11/2

For the first portion of the program, 'The Origin and Control of Residual Stress in Atomically Deposited Materials', the emphasis was placed on identifying the origin of residual stress in the model material CVD-SiC. The initial assumption was that the origin of the residual stress could be correlated with growth morphology. Parameters such as temperature, hydrogen/silane ratios, flow rates, pressure and reactant species were varied in an attempt to reveal the stress/morphology relationship. No apparent pattern emerged based on the initial assumption, but a relationship did become evident between extraneous gases and residual stress. This result required that the study program be recast along new lines that would emphasize measurement of the influence of additions of gases such as nitrogen and oxygen. Equipment was designed and set up to produce 1 in. diameter sample tubes of CVD-SiC. The arrangement permitted additions of various extraneous gases to the deposition species at concentrations that would exaggerate their influence on residual stress. This revised program has been proposed to be conducted during the next phase of the work. Author (GRA)

N78-19215# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
EXTRUSION OF SELF REINFORCED THERMOPLASTIC COMPOSITES: ILLUSTRATED WITH HIGH DENSITY POLYETHYLENE
Anagnostis E. Zachariades, Richard Ball, and Roger S. Porter 15 Jan. 1978 27 p refs
(Contract N00014-75-C-0686)
(AD-A049191; TR-9) Avail: NTIS HC A03/MF A01 CSCL 11/9

A method is described for solid state coextrusion of self-reinforced and transparent composites of high density polyethylene composed of core and sheath phases. The high density polyethylenes are coextruded below their melting points. The cocylindrical composites have a high tensile modulus and strength, a high orientation for both core and sheath components and possess considerable resistance to core/sheath separation. This resistance to pull out due to compressive and radial stresses developed during the composite coextrusion and not to bonding by epitxial crystallization. Author (GRA)

N78-19216# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
SOLID STATE COEXTRUSION: A NEW TECHNIQUE FOR ULTRADRAWING THERMOPLASTICS ILLUSTRATED WITH HIGH DENSITY POLYETHYLENE
Phillip D. Griswold, Anagnostis E. Zachariades, and Roger S. Porter 15 Jan. 1978 19 p refs
(Contract N00014-75-C-0686)
(AD-A049190; TR-8) Avail: NTIS HC A02/MF A01 CSCL 11/9

Ultra-oriented high density polyethylene (HDPE) extrudates have been prepared in continuous lengths by a new method employing conical dies of nominal draw ratios up to 36X. Preformed HDPE billets approximately equal to 7 cm (duPont Alathon 7050) were split longitudinally into two halves and then one or more wafers of the same polymer were inserted between the two sheath halves. Thereafter, the whole assembly was extruded in the absence of lubricant and at temperatures substantially below the melting range and afforded continuous and transparent films. The physical and mechanical properties of the HDPE films so produced were evaluated and compared with the respective properties of the same polymer extruded conventionally through a slit die. The high melt transitions, tensile modulus and transparencies confirm the effectiveness of the new method in obtaining continuous ultradrawn films. GRA

N78-19217# Ames Lab., Iowa.
MAGNETIC PROPERTIES OF MnPt M.S. Thesis
C. S. Severin Jun. 1977 69 p refs
(Contract W-7405-eng-82)
(IS-T-766) Avail: NTIS HC A04/MF A01

The magnetic properties of quenched and annealed powder specimens of MnPt were investigated using X-ray diffraction, magnetization measurements and neutron diffraction techniques. Thin films of MnPt were prepared by RF sputtering techniques and the films were investigated by X-ray diffraction and magnetization measurements. The powder specimens of MnPt were found to be typically antiferromagnetic in an L1 sub 0 structure with Mn atoms occupying the (001) planes. The Mn moments were antiparallel to their nearest neighbors in the (001) planes. Neutron data failed to determine whether or not Pt carried a moment. ERA

N78-19218# Sandia Labs., Albuquerque, N. Mex. NDT Technology Div.
ULTRASONIC SHEAR AND LONGITUDINAL WAVE VELOCITIES IN CMT GRAPHITE AND CARBON-CARBON (226) FROM 70 DEG F TO 5400 DEG F
J. H. Gieske Apr. 1977 102 p refs
(Contract EY-76-C-04-0789)
(SAND-76-0434) Avail: NTIS HC A06/MF A01

The temperature dependence of the shear and longitudinal velocities in CMT graphite and carbon-carbon (226) composites were determined from 70 F to 5400 F. A pulse echo method using 0.75 inch diameter rods of 8 and 7.5 inch lengths as used. Regions of the rods were placed in the hot zone of the furnace in which measurements were made of the delay times of ultrasonic echoes from a known distance in the rod at temperature. ERA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N78-19219 Michigan Univ., Ann Arbor.
DEVELOPMENT OF A PACKED-BED PHOTOCHEMICAL REACTOR Ph.D. Thesis
Thomas George Stanford 1977 122 p
Avail: Univ. Microfilms Order No. 77-26367

The reactor used in these studies had a luminescent bed 2.54 cm in diameter and 4.13 cm long containing 100 spheres of 0.635 cm diameter. The core of each luminescent sphere contained 0.3 part Pm in the form of 3M brand radiating microspheres, 3 parts GE type P-2 phosphor, and 1 part Sylgard 184 clear silicone potting resin which served as the binder. Sylgard 184 was also used to overcoat the luminescent sphere core. The Pm served as the source of exciting radiation for the phosphor. The resulting luminescent spheres had a maximum intensity in the visible region at 520 nm. Most of the energy provided by Pm was converted to heat in the luminescent sphere core; 2.2 percent of the available energy appeared as visible radiation and only about 0.04 percent of the available energy appeared as bremsstrahlung. Dissert. Abstr.

N78-19220 Ohio State Univ., Columbus.
APPLICATIONS OF VISIBLE SPECTROSCOPY IN MOLECULAR BEAM KINETICS Ph.D. Thesis
Kopin Liv 1977 220 p
Avail: Univ. Microfilms Order No. 7731923

Collision products detected by spectrally resolved light emission from the region of the intersection of crossed molecular beams were used to study electronic energy transfer in collisions of metastable Group IIB atoms (p-3) with H2, D2, N2, CO, O2, CO2, N2O, NH3, CH4, C2H4, and C2H6 in the range 2-9 kcal/mole. Energy disposal in oxidation reactions of group IIIB atoms and the internal state distributions of IIIB atom-oxide products formed under single-collision conditions were determined from laser-induced fluorescence excitation spectra, although visible chemiluminescence was employed in a few cases. Computer simulation was employed to facilitate this determination. Dissert. Abstr.

N78-19221 Case Western Reserve Univ., Cleveland, Ohio.
PHOTOFRAGMENTATION OF SELECTED GAS PHASE CATIONS Ph.D. Thesis

Robert Glenn Orth 1977 164 p
Avail: Univ. Microfilms Order No. 7731005

A prescription for estimating the kinetic energy and anisotropy of the angular distribution of photofragment ions formed by polarized and unpolarized radiation is developed for the ion cyclotron resonance cell. The photofragmentation of methyl chloride cation was examined at 366 nm. The photodissociation of N2O(+), COS(+) and CS2(+) was examined for the wavelengths ranging from 220 nm to 700 nm. The high resolution spectra of the isomers of chloropropene cations were obtained with a CW tunable dye laser in the region from 640 nm to 580 nm. The low resolution spectrum in the UV region was examined for each isomer. Dissert. Abstr.

N78-19222 California Univ., Berkeley.
CROSSED MOLECULAR BEAMS STUDY OF SOME BARIUM AND TIN REACTIONS Ph.D. Thesis
Timothy Patrick Parr 1977 210 p
Avail: Univ. Microfilms Order No. 77-31492

A crossed molecular beams machine with a universal quadrapole mass filter based detection system incorporating a time-of-flight spectrometer for velocity analysis was used to measure the center of mass product recoil angle and energy distributions for the following reactions: (1) Ba + N2O = BaO + N2, (2) Ba + CO2 = BaO + CO, (3) Ba + O2 = BaO + O, (4) Sn + Cl2 = SnCl + Cl, (5) SN + CH3I = SnI + Ch3, (6) Sn + n-C3H7I = SnI + C3H7, and (7) Sn + CCl4 = SnCl + CCl3. A minicomputer interface for collection and display of time-of-flight spectrums and product angular distributions, built using a PDP 8/e computer, is described. Dissert. Abstr.

N78-19223 Purdue Univ., Lafayette, Ind.
ELECTROLYTIC SOLUTION CHARACTERISTICS BY LASER RAMAN SPECTROSCOPY, PART 1. RAMAN SPECTROMETER INTERFACE AND COMPUTER SYSTEM DEVELOPMENT, PART 2 Ph.D. Thesis
Kuriakose Joseph Thengumthyil 1977 163 p
Avail: Univ. Microfilms Order No. 7730140

Laser Raman spectroscopic techniques were used to study the structure of cobaltate ion in tetrahydrofuran solution of NaCo(CO)4. A computer-aided data collection system was used to obtain accurate spectral contours of 0.05 M sodium tetracarbonyl cobaltate solution in the 5 micron region. Resolution of the complex spectra obtained yielded the component bands. The number of bands and their frequencies are in agreement with the infrared spectra reported earlier. A computer-spectrometer interactive system and the software for this hardware were developed to utilize the high capabilities of the PDP-11/45 computer. Dissert. Abstr.

N78-19224 California Univ., Berkeley.
EXCESS PYROLYZATE FROM DIFFUSION FLAMES Ph.D. Thesis
Tein-Mo Shih 1977 123 p
Avail: Univ. Microfilms Order No. 7731536

A system of steady, two-dimensional, laminar or turbulent flames over a vertical pyrolyzing fuel slab was analyzed. Under consideration were three flow modes, i.e., forced, free, and mixed mode convections and three regions, i.e., boundary layer trailing edge, and wake or plume. A preliminary experimental apparatus for small scale burning was designed to measure excess pyrolyzate and flame heights. Some measurements of the flame height for typical polymer fuels were taken and compared with literature results. Good agreement was achieved. Dissert. Abstr.

N78-19225 California Univ., Berkeley.
MODELING OF THE ELECTROCHEMICAL MACHINING PROCESS Ph.D. Thesis
James Beauford Riggs 1977 140 p
Avail: Univ. Microfilms Order No. 7731516

A computer implemented model for predicting ECM work piece geometry was verified by electrochemically sinking holes in copper and 302 stainless steel. A tool piece of cylindrical symmetry was chosen because it provided a two dimensional problem and also because of its mechanical simplicity. The model was developed to predict the dependence of ECM work piece geometry on the operating conditions of the process (i.e., electrolyte conductivity, applied voltage, and tool piece feed rate) and on the physical and electrochemical characteristics of the electrodes (e.g., anodic current efficiency, reversible cell potential, and charge transfer overpotential). A method of correlating characteristics of equilibrium ECM cuts with the operating variables was also presented. This method can be used to predict the operating conditions which yield the desired cut dimensions. Dissert. Abstr.

N78-19226 California Univ., Berkeley.
SIMULTANEOUS REACTIONS ON A ROTATING-DISK ELECTRODE Ph.D. Thesis
Ralph Edward White 1977 136 p
Avail: Univ. Microfilms Order No. 7731585

Multiple reactions at a rotating disk electrode were modeled for two cases. In the first case, the governing equations were used to generate a parameter which characterizes the effect of a side reaction on the limiting current curve of a main reaction. Various predicted current-potential curves illustrate the importance of this parameter for copper deposition with simultaneous formation of dissolved hydrogen at a disk electrode rotating in a copper sulfate solution containing sulfuric acid. In the second case, deposition of copper from an aqueous solution containing cupric and ferric chloride was modeled. The potential distribution and concentration profiles within the diffusion layer could be predicted for given potential differences between the electrode and the solution. Predicted current-potential and current efficiency-potential curves are also reported. Dissert. Abstr.

N78-19227 Houston Univ., Tex.
REACTION RATE SELF-OSCILLATIONS DURING THE OXIDATION OF HYDROGEN OVER PLATINUM Ph.D. Thesis
Jorge Enrique Zuniga-Chaves 1977 242 p
Avail: Univ. Microfilms Order No. 7730418

The catalyst, in the form of a long thin wire, was kept at constant resistance (temperature) by serving as an arm in the Wheatstone bridge of a constant temperature anemometer. Instantaneous reaction rates were determined from the difference in electrical power required to maintain a balanced bridge in the presence and absence of the chemical reaction. Periodic oscillations in reaction rate were observed for mixtures containing an excess of oxygen with hydrogen molar concentration in the range from .42% to .85%. Multiple steady states were observed for this system over a wide range of catalyst temperatures. They depend strongly on the surface activation process, the start-up procedure and overall history of the catalyst. The regions of multiplicity contained either time-invariant steady or oscillatory states or a combination of both. Dissert. Abstr.

N78-19228 Houston Univ., Tex.
UNSTEADY-STATE DISTILLATION ACCOMPANIED BY CHEMICAL REACTION Ph.D. Thesis
Ting-Long Wu 1977 535 p
Avail: Univ. Microfilms Order No. 77-30420

A general mathematical model was shown to represent all the four basic cases of distillation operation, by substitution of appropriate limiting values for certain terms in the theoretical equations. The reduced equations from the proposed general model included the Holland equations for unsteady state distillation without chemical reaction, the Marek equations for steady state distillation with chemical reaction, and the Thiele-Geddes equations for steady state distillation without chemical reaction. An improved numerical method, based on the Runge-Kutta formula, was used successfully to obtain the converged solution of the theoretical equations. It requires only one assumed initial value, in this instance, the outlet vapor flow rate. The experimental data obtained successfully verify the soundness of the proposed theoretical model. Dissert. Abstr.

N78-19229*# National Aeronautics and Space Administration, Washington, D. C.
USE OF A LASER FOR THE SPECTRAL ANALYSIS OF SEMICONDUCTOR MATERIALS
A. V. Karyakin, M. V. Akhmanova, and V. A. Kaygorodov Mar. 1978 7 p refs Transl. into ENGLISH from Tr. Kom. Anal. Khim. Akad. Nauk. SSSR, Inst. Geokhim. Anal. Khim., v. 16, 1968 p 59-61 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(Contract NASw-2790)
(NASA-TM-75257) Avail: NTIS HC A02/MF A01 CSCL 07D

Conventional applications of lasers for emission spectroscopy involving direct recording of light pulses of an evaporated substance emitted from the sample under the action of the laser light (direct method) were examined. Use of the laser light for conversion of the substance to a vapor and feeding the vapors into the conventional source of emission such as arc, sparks, etc. (the so called 2 stage excitation) were studied for use in the spectral analysis, of semiconductors. The direct method has a high reproducibility (5-7%); the 2 stage excitation method. characterized by the same intensity as obtained with the conventional constant, current arc, has better reproducibility than the direct method (15-20%). Both methods can be used for the analysis of samples without prior preparation. Advantages of these methods are the elimination of impurities picked up during trituration of the samples into powders and shortening of the analytical procedures. Author

N78-19230*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF CARBON BY THE OXIDATION REDUCTION REACTION WITH CHROMIUM
L. Mashkovich and A. F. Kuteynikov Mar. 1978 9 p Transl. into ENGLISH from Sovremennyye Metody Khim. Spektral'nogo Analiza Materialov (USSR), 1967 p 217-220 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75259) Avail: NTIS HC A02/MF A01 CSCL 07D

Free carbon was determined in silicon and boron carbides in ash, oxides, and other materials by oxidation to carbon dioxide with a mixture of K2Cr2O7 + H2SO4. The determination was made from the amount of CR(6) consumed, by adding excess Mohr's salt and titrating with a standard solution of KMnO4. The amount of Cr(6) self reduced was determined in a blank test. Optimum oxidation and conditions were achieved when the volumes of 5% k2Cr2Oz and H2SO4 were equal. The mixture was boiled for 1-2 hours using a reflex condenser. The volume should not be reduced, in order to avoid an increase in the sulfuric acid concentration. The relative error was 4-7% for 0.005-0.04 g C and less than or equal to 3.5% for 0.1 g C. Author

N78-19231*# National Aeronautics and Space Administration, Washington, D. C.
MECHANISM OF COMBUSTION OF SOLID CARBON
J. G. A. DeGraaf Mar. 1978 18 p refs Transl. into ENGLISH from Brennstoff-Waerme-Kraft (Netherlands), v. 17, no. 5, May 1965 p 227-231 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Central Techn. Inst., T.N.O., the Hague, (Netherlands)
(Contract NASw-2790)
(NASA-TM-75274) Avail: NTIS HC A02/MF A01 CSCL 21B

Measurements of temperature distribution in the reaction zone above the surface of carbon were studied. Using a method of spectral line reversal it was found that the minimum temperature in that zone is several hundred degrees higher than that of the carbon surface. Author

N78-19232 California State Univ., San Diego.
ANISOTROPIC REORIENTATION OF PLANAR MOLECULES MEASURED BY NUCLEAR RELAXATION IN SCALAR COUPLED SPIN SYSTEMS Ph.D. Thesis
Ruth Ellen Stark 1977 190 p
Avail: Univ. Microfilms Order No. 77-32840

Nuclear magnetic resonance methods for the investigation of liquid state dynamics were applied in this study to planar molecules containing several spin-1/2 nuclei. In order to obtain information about the anisotropy of molecular reorientation, it was necessary to use a density operator treatment of the nuclear spin dynamics, and to adopt a model for molecular tumbling which describes the relaxation process in terms of both auto and cross correlations of the various internuclear vector orientations. If the contribution to spin-lattice relaxation from intramolecular dipole-dipole interactions can be properly isolated, then it was possible to fix the motional anisotropy from a linear least squares analysis of the early time behavior observer for (1) H nuclear spin magnetizations. Corroboration of the results with (13) C and/or (2) H relaxation data was desirable. Dissert. Abstr.

N78-19233 Northwestern Univ., Evanston, Ill.
RESONANCE RAMAN AND SURFACE RAMAN SPECTRO-ELECTROCHEMISTRY Ph.D. Thesis
David Louis Jeanmaire 1977 323 p
Avail: Univ. Microfilms Order No. 7800717

Resonance Raman spectroelectrochemistry (RRSE) was shown to have experimental features which are superior to those for existing spectroelectrochemical methods in that: (1) there are few restrictions on electrode or electrochemical cell design; (2) there is essentially no spectral interference from solvent or supporting electrolyte; and (3) the technique exhibits high molecular specificity. The application of RRSE to the study of the tetracyanoquinodimethane (TCNQ) molecule and anion radical has demonstrated the value of RRSE for obtaining ground state vibrational information. This was compared with calculated bond order changes that accompany the addition of an electron to the TCNQ molecule. A study of resonance Raman excitation spectra was made for several of the totally symmetric modes of TCNQ. Dissert. Abstr.

N78-19234*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HIGH-RESOLUTION, CONTINUOUS-FLOW ELECTROPHORESIS IN MICROGRAVITY
Percy H. Rhodes Feb. 1978 36 p refs
(NASA-TM-78158) Avail: NTIS HC A03/MF A01 CSCL 07D

Approximate expressions which will allow estimation of performance enhancement in reduced gravity and will direct optimization of the various design parameters for a continuous flow electrophoresis system were devised. Other topics discussed include: (1) temperature and velocity distribution; (2) input power limitations in reduced gravity; and (3) effect of band distortion on resolution. A comparision of resolution for terrestrial and reduced gravity operations was also discussed. Author

N78-19235*# National Aeronautics and Space Administration, Washington, D. C.
USE OF ACCELERATED HELIUM-3 IONS FOR DETERMINING OXYGEN AND CARBON IMPURITIES IN SOME PURE MATERIALS
G. I. Aleksandrova, G. I. Borisov, A. M. Demidov, Ye. A. Zakharov, G. V. Sukhov, G. I. Shmanenkova, and V. P. Shchelkova Mar. 1978 8 p refs Transl. into ENGLISH from the book "Yadernofizicheskiye Metody Analiza Veshchestva" USSR, 1971 p 181-184 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(NASA-TM-75265) Avail: NTIS HC A02/MF A01 CSCL 07D

Methods are developed for the determination of O impurity in Be and Si carbide and concurrent determination of C and O impurities in Si and W by irradiation with accelerated He-3 ions and subsequent activity measurements of C-11 and F-18 formed from C and O with the aid of a gamma-gamma coincidence spectrometer. Techniques for determining O in Ge and Ga arsenide with radiochemical separation of F-18 are also described. Author

N78-19236*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF THE PURE SILICON MONOCARBIDE CONTENT OF SILICON CARBIDE AND PRODUCTS BASED ON SILICON CARBIDE
L. Prost and A. Pauillac Mar. 1978 23 p Transl. into ENGLISH from Bull. Soc. Fr. Ceram. (France), no. 84, 1969 p 75-83 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Prost establishments
(Contract NASw-2790)
(NASA-TM-75268) Avail: NTIS HC A02/MF A01 CSCL 07D

Experience has shown that different methods of analysis of SiC products give different results. Methods identified as AFNOR, FEPA, and manufacturer P, currently used to detect SiC, free C, free Si, free Fe, and SiO2 are reviewed. The AFNOR method gives lower SiC content, attributed to destruction of SiC by grinding. Two products sent to independent labs for analysis by the AFNOR and FEPA methods showed somewhat different results, especially for SiC, SiO2, and Al2O3 content, whereas

an X-ray analysis showed a SiC content approximately 10 points lower than by chemical methods. Author

N78-19237*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEFINITION AND EFFECT OF CHEMICAL PROPERTIES OF SURFACES IN FRICTION, WEAR, AND LUBRICATION
Donald H. Buckley 1978 40 p refs Proposed for Presentation at the Intern. Conf. on Tribology, Cambridge, Mass., 19-23 June 1978; sponsored by ONR, AROD, ARPA, and MIT
(NASA-TM-73806) Avail: NTIS HC A03/MF A01 CSCL 07D

Chemical properties relative to their role in adhesion, friction, wear and lubrication discussed in this paper will include: (1) adsorption, both physical and chemical; (2) orientation of the solid as well as the lubricant; (3) surface energy; (4) surface segregation; (5) surface versus bulk metallurgical effects; (6) electronic nature of the surface; and (7) bonding mechanisms. Author

N78-19238# Utah State Univ., Logan. Dept. of Chemistry and Biochemistry.
PHOTOCHEMISTRY OF TETRAFLUORODIPHOSPHINE AND CHEMISTRY OF CHELATING FLUOROPHOSPHINE LIGANDS Final Report, 1 Jun. 1974 - 31 Aug. 1977
Joseph G. Morse and Karen W. Morse 14 Dec. 1977 10 p refs
(Grant DAHC04-74-G-0209)
(AD-A048429; ARO-12335.8-C) Avail: NTIS HC A02/MF A01 CSCL 07/3

The photoreaction of tetrafluorodiphosphine with carbon-carbon multiple bonds has been shown to be a viable means for the preparation of a new class of bidentate ligand molecules. A rather wide variety of structural modifications and substituents is possible though with widely varying yields of products. These variations are rational ones viewed in terms of normal electronic and steric factors. These ligand molecules will react with amines to give a variety of additional molecules having mixed ligating sites. GRA

N78-19239# Naval Research Lab., Washington, D. C. Materials Performance Branch.
MARINE ELECTROCHEMICAL CORROSION AND CONTROL SYSTEMS Final Report
T. J. Lennox, Jr. Oct. 1977 70 p refs
(AD-A049060; AD-E000052; NRL-MR-3622) Avail: NTIS HC A04/MF A01 CSCL 13/10

Many aspects of marine corrosion and control systems are covered in this report. The major items discussed include: electrochemical theory, electrochemical reactions, types and causes of corrosion, reference electrodes, galvanic series, typical corrosion performance, corrosion characteristics, cathodic protection, and other methods of corrosion control. Antifouling systems are also discussed. Appendices include a glossary of corrosion terms and a metric guide with selected conversion factors. Author (GRA)

N78-19240# Argonne National Lab., Ill.
FINE DEFINITION OF IR SPECTRA FOR CERTAIN METALLIC OXIDE SPECIES Final Report, 1 Jul. 1975 - 30 Sep. 1976
D. W. Green and G. T. Reedy Jun. 1977 30 p refs
(AD-A048814; AD-E300068; DNA-4390F) Avail: NTIS HC A03/MF A01 CSCL 07/4

The reactions between U, UO or UO2 and NO or NO2 have been studied by cocondensation of the reactants in Ar matrices at 14 K. Infrared spectra of the species in the matrices were recorded with a Fourier transform spectrometer. The vibrational mode frequencies of several new species were identified by use of isotopic substitution. The UO2(+) ion was produced by three different reactions and was found to be linear. The nitrides of uranium, UN and UN2, were produced by two methods; UN2 was found to be linear. The species UO(+) could not be produced in sufficient quantities to be observed by any of the following reactions: U NO2, U NO or UO I. Author (GRA)

N78-19241# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.
RATIONAL SYNTHESIS OF NEW UNIDIMENSIONAL OF MIXED VALENCE POLYIODIDES
Tobin J. Marks 28 Dec. 1977 41 p refs
(Contract N00014-77-C-0231)
(AD-A049182; TR-1) Avail: NTIS HC A03/MF A01 CSCL 07/3

This article surveys recent research in the author's laboratory on rationally synthesizing mixed valence materials, and on studying physicochemical properties of the resulting products. The resonance Raman/iodine-129 Mossbauer technique for charge distribution analysis is first outlined, then results in the areas of partially-oxidized bisdioximates and phthalocyanines are discussed. Author (GRA)

N78-19242# Rhode Island Univ., Kingston. Dept. of Ocean Engineering.
CHARACTERIZATION OF PASSIVE FILMS USING INFRARED AND RAMAN SPECTROSCOPY Annual Report, 1 Jan. - 31 Dec. 1977
R. Heidersbach, C. Brown, R. Thibeau, and A. Goldfarb Jan. 1978 33 p
(AD-A049170; TR-2) Avail: NTIS HC A03/MF A01 CSCL 07/4

This report discusses research using infrared (IR) and Raman spectroscopy as the primary investigative tools to study passive film formation. Equipment adapted for this purpose is described. Results of studies on lead and iron are presented. The results are analyzed by comparison with thermodynamic data. A tentative new version of Pourbaix's potential -pH diagram for lead in nil-chloride aqueous solutions is presented. Author (GRA)

N78-19243# Air Force Geophysics Lab., Hanscom AFB, Mass.
INFRARED FLUORESCENCE OF ELECTRON IRRADIATED CO SUB 2 IN THE PRESENCE OF N SUB 2, Ar, AND He, ENVIRONMENTAL RESEARCH PAPERS
Randall E. Murphy, Floyd H. Cook, G. E. Caledonia, and B. D. Green (Physical Sciences, Inc., Woburn, Mass.) Hanscom AFB, Mass. AFGL 15 Sep. 1977 95 p refs
(AD-A049302; AFGL-TR-77-0205; AFGL-ERP-609) Avail: NTIS HC A05/MF A01 CSCL 07/4

A series of measurements of the time dependent infrared fluorescence histories of electron irradiated mixtures of CO2/X (X=Ar, He, N2) have been performed. Fundamental band CO and CO2 (nu) band radiation observed in these studies have been analyzed in some detail and rate constants for the processes CO(v) + CO2 yields CO(v - 1) + CO2*, v < or = 12 have been determined from the data. Author (GRA)

N78-19244# Cornell Univ., Ithaca, N. Y. Center for Applied Mathematics.
STUDIES IN ROTATIONAL FLOWS ESPECIALLY ASYMPTOTIC METHODS Final Report, 1 Nov. 1974 - 15 Sep. 1977
G. S. S. Ludford Oct. 1977 10 p refs
(Grants DAHC04-75-G-0016; DAAG29-76-G-0026)
(AD-A049217; ARO-12373.30-M) Avail: NTIS HC A02/MF A01 CSCL 21/2

Modern asymptotic methods have been used to investigate (1) combustion, in particular monopropellant decomposition in inert and reactive atmospheres, fuel-drop burning, quenching of plane deflagration waves, burning of solids and liquids, separated flames, slowly varying flames (e.g. in ducts), flame stretch, stability, quenching of multi-dimensional flames and chambered diffusion flames; (2) entry flow and inertial effects in magnetohydrodynamic ducts under strong transverse magnetic fields; (3) viscous sheets advancing over dry beds. Details of the results are contained in the 28 Technical Reports and 3 Theses. GRA

N78-19245# Ames Lab., Iowa. Dept. of Materials Science and Engineering.
SCANDIUM PUZZLE: WHAT ARE ITS INTRINSIC PROPERTIES?
K. A. Gschneider, Jr., T. W. E. Tsang, J. Queen, S. Legvold, and F. A. Schmidt 1977 15 p refs Presented at the Intern. Conf. on Rare Earths and Actinides, Durham, Engl., 4-6 Jul. 1977
(IS-M-99; Conf-770717-2) Avail: NTIS HC A02/MF A01

The heat capacity of three different electrotransport refined Sc samples were measured from 1 to 20 K. The resultant gamma

and theta sub D values are 10.337 + or - 0.015 millijoules/gram-at. K to the 2 power and 346.7 + or - 0.8 K, respectively. The influence of Mg, Fe, and Zr impurities on the heat capacity was studied. In the case of Fe a variety of results can be obtained by changing the Fe concentration and heat treatment - both a pure Kondo and a spin glass system appeal to exist in these alloys. The effect of electron concentration (Mg lowers it and Zr increases it) changes are consistent with theoretical band structures and appear to explain the variation of gamma with Mg or Zr additions. The change in theta sub D with these two alloying agents is anomalous and has yet been explained. The results of electrical resistivity measurements on electrotransport refined Sc single crystals are also presented. Author

N78-19246# Los Alamos Scientific Lab., N. Mex.
EQUATION-OF-STATE FOR FLUIDS AT HIGH DENSITIES-HYDROGEN ISOTOPE MEASUREMENTS AND THERMODYNAMIC DERIVATIONS
D. H. Liebenberg, R. L. Mills, and J. C. Bronson 1977 25 p refs Presented at the 6th AIRAPT Intern. High-Pressure Conf., Boulder, Colo., 25-29 Jul. 1977
(Contract W-7405-eng-36)
(LA-UR-77-1502; Conf-770706-23) Avail: NTIS HC A02/MF A01

Hydrogen isotopes were involved in the compression to high densities for initiation of controlled thermonuclear fusion energy. At high densities the properties of the compressed hydrogen isotopes departed drastically from ideal thermodynamic predictions. An equation-of-state was fit to these data with a double-process least-squares computer program. The results were reviewed and compared with existing data and with a variety of theoretical work reported for fluid hydrogens. A new heuristic correlation is presented for simplicity in predicting volumes and sound velocity at high pressures. ERA

N78-19247# Rochester Univ., N. Y. Dept. of Chemistry.
CALCULATION OF THE MEAN FORCE CONSTANTS OF THE RARE GASES AND THE RECTILINEAR LAW OF MEAN FORCE
M. W. Lee and J. Bigeleisen 1977 25 p refs
(Contract EY-76-S-02-3498)
(COO-3498-32) Avail: NTIS HC A02/MF A01

The mean energies, (U), and the mean force constants, nabla squared U were calculated for liquid argon and liquid krypton using the perturbation theory, and for gaseous argon and krypton along the coexistence line by solution of the PY equation for the radial distribution function. Correlation of the calculated values of nabla squared U for the liquid and gas leads to an empirical relationship between nabla squared U and the density of the phase along the coexistence line. It is shown that the scaling exponent for the mean force constant nabla squared U/sub 1-nabla squared U/sub g/. is larger than the scaling exponent of the density below the critical temperature and becomes equal to it at the critical temperature. ERA

N78-19248# Tata Inst. of Fundamental Research, Bombay (India).
RADIOCHEMISTRY OF BISMUTH
K. S. Bhatki Oak Ridge, Tenn. ERDA Sep. 1977 148 p refs Sponsored by ERDA and NAS-NRC
(NAS-NS-3061) Avail: NTIS HC A07/MF A01

The nuclear and chemical features of particular interest to the radiochemist are reviewed. A discussion of important analytical procedures such as precipitation, solvent extraction, ion exchange, paper chromatography, electroanalytical separations, and volatilization is included, together with gravimetric, volumetric, and photometric methods and a discussion on problems of dissolution of a sample. Also included are various radioactivity counting techniques and a collection of radiochemical procedures for bismuth as found in the literature. ERA

N78-19249# Kent State Univ., Ohio.
ENERGETIC-NEUTRON SPECTROMETRY Progress Report, 1 Jun. 1976 - 31 Aug. 1977
R. Madey 1977 20 p
(Contract EY-76-S-02-2231)
(COO-2231-38) Avail: NTIS HC A02/MF A01

Advances in instrumentation and techniques for energetic-neutron spectrometry included the development of large-volume scintillators and a mean-timer electronic module to provide subnanosecond timing resolutions for time-of-flight measurements. Improved energy resolutions, new determinations of the light response to protons, scintillators, and the development of a multiplexing technique to permit the operation of several different counters simultaneously with our transportable data-acquisition system are presented. Measurements demonstrating and utilizing these advances include neutron energy and angular distributions. A discussion of a planned experiment to measure neutron spectra from heavy-ion reactions was included. ERA

N78-19250# Argonne National Lab., Ill.
MATRIX ISOLATION STUDIES WITH FOURIER TRANSFORM IR
David W. Green and Gerald T. Reedy 1977 5 p refs Presented at Intern. Conf. on Matrix Isolation Spectry., West Berlin, Jun. 1977
(Contract W-31-109-eng-38)
(CONF-770657-1) Avail: NTIS HC A02/MF A01

Some advantages of the FT-IR spectrometer over the grating spectrometer are the result of the computerized data system that is a necessary part of the FT-IR spectrometer; other advantages are a consequence of the difference in optical arrangements and these represent the inherent advantages of the FT-IR method. In most applications with the matrix isolation technique, the use of FT-IR spectroscopy results in either an improved signal to noise ratio or a shorter time for data collection compared with grating infrared spectroscopy. Fourier transform infrared spectroscopy was used in a laboratory to study several molecular species in low temperature matrices. Some species were produced by high temperature vaporization from Knudsen cells and others by sputtering. By sputtering, Ar and Kr matrices were prepared which contain U atoms, UO, UO2, UO3, PuO, PuO2, UN, or UN2, depending upon the composition of the gas used to sputter as well as the identity of the metallic cathode. Infrared spectra of matrices containing these compounds are presented and discussed. Author (ERA)

N78-19251# Los Alamos Scientific Lab., N. Mex.
CARBONATION OF CERIUM OXYCHLORIDE
E. J. Peterson, E. I. Onstott, and M. G. Bowman 1977 7 p refs Presented at the 13th Rare Earth Res. Conf., Olgebay Park, W. Va., 16-20 Oct. 1977
(Contract W-7405-eng-36)
(LA-UR-77-2030; Conf-771039-1) Avail: NTIS HC A02/MF A01

Cerous carbonates can be used in thermochemical cycles for H production if the resulting ceric oxides can be converted back into cerous carbonates. One way is to reduce and hydrolyze ceric oxide with HCl to produce CeOCl and then to carbonate it. The reaction 3CeOCl + 3CO2 + 8H2O yields CeCl3(aq) + Ce2 (CO3)3. The 8H2O was found to occur in aqueous medium if the final CeCl3 content is low. Carbonation of CeOCl could also be conducted in acetone -H2O. The CeClCO3 3H2O was decomposed and characterized. The reactions which can be used for water splitting are discussed briefly. ERA

N78-19252# Los Alamos Scientific Lab., N. Mex.
THERMOPHYSICAL PROPERTIES: SOME EXPERIENCE IN RESEARCH, DEVELOPMENT AND APPLICATIONS
P. Wagner and R. U. Acton (Sandia Labs., Albuquerque, N. Mex.) 1977 8 p refs Presented at the Intern. Thermal Expansion Symp., Winnipeg, Canada, 29-31 Aug. 1977
(Contract W-7405-eng-36)
(LA-UR-77-1881; Conf-770843-2) Avail: NTIS HC A02/MF A01

Accurate measurements of thermophysical properties, understanding exactly any use requirements, and understanding the behavior of the material are all potential ingredients for in-depth research and development projects. Some of LASL and SLA projects and their chain-branching manifestations are briefly described. ERA

N78-19253# Massachusetts Inst. of Tech., Cambridge.
LUMINESCENCE PROCESS, REFRACTORY STABILITIES, AND NEW NOVEL ELECTRONIC STATES: SCANNING CHEMICAL REACTIONS AND NOVEL PRODUCTS FOR LASER INDUCED ISOTOPE SEPARATION Progress Report,

1 Dec. 1975 - 15 Jul. 1976
J. L. Gole Aug. 1976 18 p
(Contract EY-76-S-02-0269)
(COO-2569-3) Avail: NTIS HC A02/MF A01

The formulation, development, and use of versatile oven systems for high temperature metal vaporization at temperatures in excess of 2000 C are discussed. Refinements of an apparatus appropriate for the production and study of small metal aggregates are discussed. Improvements in the argon ion and nitrogen pumped dye laser systems, and necessary additions for effective interfacing of these dye lasers to the aggregates apparatus are described. Internal calibration standards are discussed. Progress on the production of carbon vapor and the reaction of this vapor with metal atoms and metal dimers to form metal carbides is outlined and metal sulfide chemistry is discussed. ERA

N78-19254# Argonne National Lab., Ill.
RADIOCHEMISTRY OF IODINE
M. Kahn and J. Kleinberg Sep. 1977 109 p refs
(NAS-NS-3062) Avail: NTIS HC A06/MF A01

The preparation of isotopes of the element, with selected procedures for its determination in or separation from various media is described along with the separating of iodine species from each other. For the preparative and analytical sections there is an extensive, indexed bibliography. ERA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N78-19255 Northwestern Univ., Evanston, Ill.
SULFUR TRANSPORT IN NICKEL OXIDE Ph.D. Thesis
Wei-Yean Howng 1977 143 p
Avail: Univ. Microfilms Order No. 77-32313

Tracer diffusion of sulfur-35 in nickel oxide single crystal was studied as a function of temperature, oxygen partial pressure, and foreign atom dopants. In the temperature range 1000 - 1250 C, the measured data were found to deviate markedly from the error function complement dependence for diffusion from a constant source. The deviation is attributed to sulfur migration by double-mode-simultaneous-diffusion mechanism. The fast mode diffusivities were found to increase in Cr-doped and decrease in Li-doped NiO single crystals. On the contrary, the slow mode diffusivities were found to decrease in Cr-doped and increase in Li-doped NiO single crystals. These results suggest that sulfur tracer atoms migrate via nickel vacancies in fast diffusion mode and via oxygen vacancies in slow diffusion mode. The diffusion mechanisms were consistent with the studies of sulfur diffusion under low oxygen partial pressures.
Dissert. Abstr.

N78-19256 Ohio State Univ., Columbus.
CURRENT DISTORTION EFFECTS IN THE MAGNETO-TRANSPORT PROPERTIES OF INHOMOGENEOUS METALS Ph.D. Thesis
Jeffrey Brian Sampsell 1977 92 p
Avail: Univ. Microfilms Order No. 77-31969

The galvanomagnetic properties of inhomogeneous simple metals were investigated. A number of systems believed to be affected by sample inhomogeneities are described, and several models dealing with the effects of inhomogeneities on transport properties are discussed. The specific model to be used was introduced and employed to calculate the magnetoresistance in free-electron metals caused by nonconducting volume inhomogeneities. The calculation is extended to model the magnetoresistance of polycrystalline copper in terms of open-orbit inclusions in a free-electron background. The difficulties involved in making sensitive measurements of galvanomagnetic properties in pure metals at low temperatures are discussed. An experiment is described which is capable of concurrent measurements of electrical resistivity, thermal conductivity, and various thermoelectric coefficients. Dissert. Abstr.

N78-19257 Cornell Univ., Ithaca, N. Y.
A NUCLEAR MAGNETIC RESONANCE STUDY OF THE ALKALI TUNGSTEN BRONZES Ph.D. Thesis
Bernard Robert Weinberger 1977 112 p
Avail: Univ. Microfilms Order No. 78-00113

The electronic structure of the cubic alkali tungsten bronzes has been probed through a nuclear magnetic resonance study of (W-183) resonance in Na(x)W03 and the (W-183) and (Li-7) resonance in Li(x)W03. The spin lattice relaxation rate, T1, and the Knight shift, K, of (W-183) in both Na(x)W03, and Li(x)W03 were measured as a function of x, the alkali concentration. (W-183) absorption lineshapes in Na(x)W03 were also obtained. (W-183) measurements were performed at both 1.35 and 4.2 K. Measurements of T1 and K of (Li-7) in Li(x)W03 were also obtained as a function of lithium concentration. Room temperature and liquid nitrogen temperature measurements were made. A model is proposed based upon admixture of alkali levels and tungsten 5d and 6s levels. Dissert. Abstr.

N78-19258 California Univ., Berkeley.
A THEORY OF DISLOCATIONS FOR METALS Ph.D. Thesis
Mohssen Mohaghegh 1977 83 p
Avail: Univ. Microfilms Order No. 77-31468

A purely mechanical theory of dislocations is constructed within the scope of nonlinear continuum mechanics, and the relationship of the results to those of the existing theory of elastic-plastic materials is established. Preliminary to the main developments, some background information from the material science point of view is provided and this is followed by kinematical results appropriate for an elastic-plastic continuum. Guided by the behavior of elastic-plastic materials and physical observations concerning dislocations, basic principles and constitutive equations for dislocations are introduced. The constitutive equations are of the rate type and describe the rate independent behavior of dislocations in metals. A specific example is worked out and the results are compared with some available experimental data. The relationship of the present theory with that of elastic-plastic materials is demonstrated. Dissert. Abstr.

N78-19259*# Kentucky Univ., Lexington. Dept. of Metallurgical Engineering and Materials Science.
THE EFFECT OF MINOR ADDITIONS OF TITANIUM ON THE FRACTURE TOUGHNESS OF Fe-12Ni ALLOYS AT 77K Final Report, 1 Nov. 1976 - 31 Oct. 1977
H. Conrad, C. Yin, and G. Sargent 16 Jan. 1978 92 p refs
(Grant NsG-3125)
(NASA-CR-135351) Avail: NTIS HC A05/MF A01 CSCL 11F

Titanium additions ranging from 0.18 to 0.99 atomic percent and heat treatments of 2 hours at 550, 685 and 820 C respectively followed by a water quench were considered. Cubic and rectangular shaped inclusions were noted in the SEM fractographs of the alloys with the Ti additions. A fine precipitate was observed by TEM for the Fe-12Ni-0.18Ti alloys heat treated at 550 C; this precipitate was not observed for the 685 and 820 C heat treatments of the same alloy. Auger mappings of the fracture surfaces indicated a weak to moderate association of the interstitials C, N and O with Ti, the degree of which depended on the particular interstitial and the heat treatment temperature.
Author

N78-19260*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
PREPARATION OF AMORPHOUS FERROMAGNETIC MATERIALS THROUGH CONTAINERLESS SOLIDIFICATION
A. E. Lord, Jr. (Drexel Univ.), Gerald Wouch, and R. T. Frost 27 Jan. 1978 28 p refs
(Contract NAS8-31972)
(NASA-CR-150584) Avail: NTIS HC A03/MF A01 CSCL 11F

The work reported herein consists of: (1) the ground based experiments; (2) the analysis of the ground based specimens; (3) the flight experiment; (4) failure to melt analysis; and (5) recommendations and conclusions. The ground based experimental work yielded new results in terms of understanding the viscoelastic properties of ferromagnetic metallic glasses and the variation of viscosity through the glass transition temperature from metallic glass to crystalline solid. This last result was of

importance in predicting what glass can be produced at lower quench rates. Author

N78-19261*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CORRELATIONS BETWEEN ULTRASONIC AND FRACTURE TOUGHNESS FACTORS IN METALLIC MATERIALS
Alex Vary 1978 18 p refs Proposed for Presentation at the 11th Symp. on Fracture Mech., Blacksburg, Va., 12-14 Jun. 1978
(NASA-TM-73805) Avail: NTIS HC A02/MF A01 CSCL 11F

A heuristic mathematical basis was proposed for the experimental correlations found between ultrasonic propagation factors and fracture toughness factors in metallic materials. A crack extension model was developed wherein spontaneous stress (elastic) waves produced during microcracking are instrumental in promoting the onset of unstable crack extension. Material microstructural factors involved in the process are measurable by ultrasonic probing. Experimental results indicate that ultrasonic attenuation and velocity measurements will produce significant correlations with fracture toughness properties and also yield strength. Author

N78-19262*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRINCIPLES OF ESCA AND APPLICATION TO METAL CORROSION, COATING AND LUBRICATION
Donald R. Wheeler 1978 15 p refs Presented at the Symp. on Mod. Metallog. Tech. and Their Appl., Cleveland, 10-11 Apr. 1978
(NASA-TM-78839) Avail: NTIS HC A02/MF A01 CSCL 11F

The principles of ESCA (electron spectroscopy for chemical analysis) were described by comparison with other spectroscopic techniques. The advantages and disadvantages of ESCA as compared to other surface sensitive analytical techniques were evaluated. The use of ESCA was illustrated by actual applications to oxidation of steel and Rene 41, the chemistry of lubricant additives on steel, and the composition of sputter deposited hard coatings. A bibliography of material that was useful for further study of ESCA was presented and commented upon. Author

N78-19263*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NUMERICAL ANALYSES FOR TREATING DIFFUSION IN SINGLE-, TWO- AND THREE-PHASE BINARY ALLOY SYSTEMS
Darrel R. Tenney and Jalaiah Unnam (George Washington Univ.) Mar. 1978 28 p refs
(NASA-TM-78636; L-11840) Avail: NTIS HC A03/MF A01 CSCL 11F

Numerical solutions were applicable for planar, cylindrical, or spherical geometries with any diffusion-zone size and any continuous variation of the diffusion coefficient with concentration. Special techniques were included in the analyses to account for differences in molal volumes, initiation and growth of an intermediate phase, disappearance of a phase, and the presence of an initial composition profile in the specimen. A major improvement in solution accuracy was achieved in the two phase analysis by employing a mass conservation criterion to establish the location of the interface rather than the conventional interface-flux-balance criterion. In the three phase analysis, computation time was minimized without sacrificing solution accuracy by treating the three phase problem as a two phase problem when the thickness of the intermediate phase was less than a preset small value. Three computer codes were developed to perform these analyses. Author

N78-19264# RCA Labs., Princeton, N. J.
BASIC ADHESION MECHANISMS IN THICK AND THIN FILMS Quarterly Report, 1 Jul. - 30 Sep. 1977
Thomas T. Hitch and Kenneth R. Bube Nov. 1977 34 p refs (Contract N00019-77-C-0176)
(AD-A048618; PRRL-77-CR-47; QR-3) Avail: NTIS HC A03/MF A01 CSCL 11/6

In the study of frit-bonded materials this quarter, the sintering of gold powders was studied and indicated to be assisted by the presence of a lead borosilicate glass in the second stage of sintering (solution-precipitation) at higher temperatures. The evolution of organic-vehicle-burnoff gas products from sintering gold and gold/glass powders was also investigated. For the materials studied, which were typical of thick-film paste constituents, it was concluded that organic burnout should not interfere with the sintering of most gold powders. It was further determined that at the completion of burnout, the organic burnoff gases should be able to escape through the glass phase rapidly enough to prevent their entrapment in the partially sintered structure. GRA

N78-19265# Connecticut Univ., Storrs. Dept. of Metallurgy.
INTERNAL SACRIFICIAL ANODES IN HIGH STRENGTH ALUMINUM ALLOYS Final Report, 1 Oct. 1975 - 30 Sep. 1977
A. J. McEvily and J. E. Morral Nov. 1977 9 p refs (Grant DAAG29-76-G-0061)
(AD-A048325; ARO-12319.1-MS) Avail: NTIS HC A02/MF A01 CSCL 11/6

Efforts directed toward the development and assessment of a quantitative approach of the stress-corrosion cracking of Al-Zn-Mg alloys in salt water environments are described. Author (GRA)

N78-19266# California Univ., Berkeley. Dept. of Mechanical Engineering.
DUCTILE FRACTURE IN AXISYMMETRIC EXTRUSION AND DRAWING. PART 1: DEFORMATION MECHANICS OF EXTRUSION AND DRAWING. PART 2: WORKABILITY IN EXTRUSION AND DRAWING Final Report, Mar. 1976 - Mar. 1977
C. C. Chen, S. I. Oh, and Shiro Kobayashi Jun. 1977 126 p refs (Contract F33615-75-C-5151)
(AD-A048842; AFML-TR-77-96) Avail: NTIS HC A07/MF A01 CSCL 13/8

This investigation applies theories on flow and fracture in metalworking processes to prediction of workability of materials in axisymmetric bar extrusion and drawing, with special reference to central bursting. Part 1 deals with the determination of deformation mechanics in extrusion and drawing. The matrix method is used as the method of analysis and is shown to be an efficient numerical method which provides useful information on the detailed deformation characteristics for various process variables. In part 2 the validity of a theory on ductile fracture was examined by experimental data found in the literature. Then, combining the formulation of fracture criteria with the deformation mechanics found in Part 1, the workability of materials in extrusion and drawing was determined. Workability in extrusion was examined for aluminum alloy 2024-T351, using data found in the literature, and experiments of workability in drawing were attempted for SAE 1144 colddrawn steel to test the prediction. The results of validation were inconclusive. Conclusive validation of the present workability theory in extrusion and drawing awaits more extensive and systematic experimental investigations, as well as theoretical calculations. Author (GRA)

N78-19267# Naval Research Lab., Washington, D. C. Metal Physics Branch.
SPIN FLUCTUATIONS AND THE PARAMAGNETIC-FERROMAGNETIC TRANSITION IN PALLADIUM-RHODIUM-NICKEL ALLOYS Interim Report
D. J. Gillespie Oct. 1977 286 p refs (RR0220146)
(AD-A049154; AD-E000056; NRL-MR-3630) Avail: NTIS HC A13/MF A01 CSCL 20/3

Low-temperature (1-20 K) low-field (1/2-4 kG) magnetization and low-temperature (1-20 K) zero-field electrical resistivity measurements have been made on a series of (Pd95Rh5)1-xNix alloys ($x < or = 0.03$). At 4 K the magnetization measurements were extended to 56 kG, and in the case of the more dilute alloys the resistivity measurements were extended to 300 K. Curie temperatures and spontaneous magnetization obtained by an Arrott plot analysis of the magnetization data yield a critical concentration for the onset of ferromagnetism of 1.9 + or - 0.05 at % Ni. In the paramagnetic region the magnetization, susceptibility (dM/dH), and resistivity are well fitted by a model which considers local spin fluctuations to be associated with two types of magnetic center: a pair of interacting Ni atoms

and a single noninteracting Ni atom. The local enhancement associated with a Ni pair is found to be roughly 3 to 4 times as large as that of a noninteracting Ni atom. The spin-fluctuation temperature and the characteristic-field parameter are, respectively, T sub s = 59 + or - 4 K and H sub s = 225 + or - 25 kG for the noninteracting Ni atom, and T sub s = 18 + or - 8 K and H sub s = 35 + or - 5 kG for the Ni pair. In the ferromagnetic alloys the magnetization of a large number of the Ni atoms appears to remain unsaturated at 4 K. The results for this system are compared with corresponding results for the Pd(1-x)Nix system. Author (GRA)

N78-19268# Naval Research Lab., Washington, D. C. Thermo-structural Materials Branch.

EVALUATION OF COMMERCIAL PRODUCTION A533-B STEEL PLATES AND WELD DEPOSITS WITH EXTRA-LOW COPPER CONTENT FOR RADIATION RESISTANCE Final Report

J. R. Hawthorne, J. J. Koziol (Combustion Eng., Inc., Windsor, Conn.), and S. T. Byrne (Combustion Eng., Inc., Windsor, Conn.) Oct. 1977 42 p refs

(Contract AT(49-24)-0207)

(AD-A049112; AD-E000074; NRL-8136) Avail: NTIS HC A03/MF A01 CSCL 13/8

A cooperative research program by the U.S. Nuclear Regulatory Commission (NRC), Combustion Engineering, Inc., (CE), and the Naval Research Laboratory (NRL) has explored trends in radiation effects for commercially produced ASTM A533-B steel plates, weld deposits, and weld heat-affected zones, depicting three levels of control over impurity copper content. The primary objective was to establish the trend of improved 288 C (550 F) radiation resistance with progressive reductions in allowable copper content. An overall objective was to develop information assisting the formulation of special specifications for steels for nuclear service and the delineation of associated embrittlement trends for reactor vessel design and operation. This report describes investigations on Series 3 materials, which represent optimum steel-making practice, and a limitation on copper content of 0.06% Cu maximum. Previous investigations on Series 1 materials (> or = 0.15% cu) typical of nonimproved steel production (pre-1971) and Series 2 materials (0.10% Cu, max) representative of improved steel production (current practice) are also summarized. Radiation resistance was assessed from Charpy-V (Cv) notch ductility changes with fluences of approx. 5 to 7 x 10 to the 19th power n/sq cm = 1 MeV. All Series 3 materials exhibited high resistance to radiation in terms of both transition temperature elevation and upper shelf degradation. Typically, the postirradiation Cv 41 J(30 ft-lb) transition-temperature elevation was less than 56 C (100 F). GRA

N78-19269# Naval Research Lab., Washington, D. C. Thermo-structural Materials Branch.

EFFECT OF HOLD TIME AND THERMAL AGING ON ELEVATED TEMPERATURE FATIGUE CRACK PROPAGATION IN AUSTENITIC STAINLESS STEELS Interim Report

D. J. Michel and H. H. Smith Oct. 1977 46 p refs

(Contract E(49-5)-2110; RR0221141)

(AD-A049153; AD-E000058; NRL-MR-3627) Avail: NTIS HC A03/MF A01 CSCL 11/6

The effects of combined cyclic and static loading on fatigue crack propagation in thermally aged and unaged Types 304, 316, 321, and 348 stainless steels were investigated at 427 and 593 C. The Types 304 and 316 steels were evaluated in both the solution annealed and cold worked conditions. The results show that aging and hold time produce no significant effect on crack propagation rate at 427 C. At 593 C, the effects of aging on crack propagation performance were most significant for the Type 316 steel and related to thermomechanical history. Thermal aging decreased the crack propagation rate in solution annealed Type 316 steel at 539 C and increased the propagation rate in cold worked material. The effect of hold time at 593 C was to increase crack propagation rate with increased hold period in Type 316 steel. In the cold worked Type 316 steel, thermal aging reduced the magnitude of the hold time effect. SEM examination of the fracture surfaces of both solution annealed and cold worked Type 316 specimens tested at 593 C revealed a transition from transgranular to intergranular failure mode with increasing hold time in the unaged condition. After thermal aging, the failure mode was transgranular for all hold times. TEM study of the aged and unaged microstructures indicated the presence of profuse grain boundary precipitates identified as M23C6. Consideration was given to influence of both environmental effects and the intergranular precipitates on the transition in failure mode. GRA

N78-19270# Stanford Univ., Calif. Dept. of Materials Science and Engineering.

FINE STRUCTURE AND SUPERPLASTICITY IN ULTRAHIGH CARBON STEELS Semiannual Progress Report, 1 Jan. - 30 Jun. 1977

J. Wadsworth, J. T. Lo, B. Walser, Robert Caligiuri, and O. D. Sherby 30 Jun. 1977 102 p refs

(Contract N00014-77-C-0149)

(AD-A049146; SAPR-1) Avail: NTIS HC A06/MF A01 CSCL 11/6

This program centers on a study of the mechanical behavior of ultrahigh carbon (UHC) steels in the range 1% to 2.4% carbon. These UHC steels were developed at Stanford University during 1973-1976. They were shown to be superplastic at warm temperatures (600 to 800 C) and strong and ductile at room temperature. The objectives of our present study are threefold: (1) to alter the chemistry of the UHC steels in order to optimize superplastic characteristics at elevated temperature and strength and ductility characteristics at room temperature, (2) to investigate various thermal-mechanical processing procedures for obtaining the desired microstructure in the UHC steels and (3) to utilize superplasticity in solid state bonding of similar and dissimilar steels. GRA

N78-19271# Naval Research Lab., Washington, D. C. Thermo-structural Materials Branch.

IRRADIATION EFFECTS ON FATIGUE CRACK PROPAGATION IN AUSTENITIC STAINLESS STEELS

D. J. Michel Sep. 1977 36 p refs

(Contract E(49-5)-2110)

(AD-A049119; AD-E000048; NRL-MR-3610) Avail: NTIS HC A03/MF A01 CSCL 11/6

The effects of fast neutron irradiation on subcritical crack propagation in austenitic stainless steels are reviewed with respect to the influence of irradiation and test temperatures, neutron fluence, hold time effects, and thermomechanical history. Predictive methods for estimating crack propagation performance are discussed. Author (GRA)

N78-19272# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.

NEW LOW-DIMENSIONAL MOLECULAR METALS: SINGLE CRYSTAL ELECTRICAL CONDUCTIVITY OF NICKEL PHTHALOCYANINE IODIDE

C. J. Schramm, D. R. Stojakovic, B. M. Hoffman, and T. J. Marks 28 Dec. 1977 16 p refs

(Contract N00014-77-C-0231)

(AD-A049183; TR-2) Avail: NTIS HC A02/MF A01 CSCL 11/6

The highly anisotropic and sometimes spectacular electrical, magnetic, and optical characteristics of molecular materials with strongly one-dimensional interactions have made them of great current interest to chemists and physicists. As part of our efforts to obtain a better understanding of, and chemical control over, the fundamental properties of such materials, we recently synthesized an extensive new class of highly conductive molecular solids, containing stacks of metallophthalocyanine (MPc) molecules. These were made via a preparative procedure which utilizes iodine oxidation to afford lattices composed of one-dimensional arrays of planar donor molecules (in this case MPc units) with fractionally occupied electronic valence shells ('partial oxidation' or 'mixed valence') and chains of polyiodide counterions. Author (GRA)

N78-19273# Ocean City Research Corp., N.J.

FURTHER EVALUATION OF SELECTED PROTECTIVE COATINGS APPLIED UNDER ADVERSE CONDITIONS Final Report

George A. Gehring, Jr. and Doreen L. Behmke Lakehurst, N. J. Naval Air Engineering Center 16 Dec. 1977 35 p

(Contract N68335-76-C-4458)
(AD-A049187; NAEC-eng-7936) Avail: NTIS HC A03/MF A01 CSCL 11/3

Effective protective coatings are required to prevent corrosion of hardware components around the launch area of aircraft carriers. The uniquely severe environment characteristic of the launch area, as well as the adverse conditions under which coating maintenance must be accomplished, has made selection of an optimum coating doubtful. The results of 1 year simulated exposure tests indicate that a MIL SPEC epoxy coating applied in 2 or 3 coats to achieve an 8 mil build is equal to any of the maintenance-type coatings presently available and should have an adequate service life. The results also suggest that, where complete removal of rust is not possible, a zinc chromate primer available within the Navy Supply System is equal to the proprietary 'rust-stabilizing' primers currently on the market.

Author (GRA)

N78-19274# Army Materials and Mechanics Research Center, Watertown, Mass. Metals Research Div.

TRANSFORMATION BEHAVIOR OF TRIP STEELS Final Report

Gregory B. Olson and Morris Azrin Oct. 1977 22 p refs
(DA Proj. 1T1-62105-AH-84)
(AD-A049143; AMMRC-TR-77-25) Avail: NTIS HC A02/MF A01 CSCL 11/6

Recent true-stress, true-strain measurements of the tensile flow properties of high-strength TRIP steels designed to incorporate the initial region of localized flow associated with Luders band formation have called attention to a large apparent strain-rate sensitivity of the uniform ductility. This apparent strain-rate effect was interpreted as originating from the temperature dependence of the kinetics of the deformation-induced martensitic transformation which controls the work-hardening behavior of these metastable austenitic steels. Efforts to understand the transformation kinetics and its relation to flow properties in high-strength TRIP steels have been hampered by a lack of experimental information from the region of initial inhomogeneous flow that represents such an important part of the deformation behavior of these materials. The present study was undertaken to extend true-stress, true-strain, and volume fraction martensite measurements to the region of Luders band formation in order to elucidate the transformation kinetics and its relation to flow properties as a function of temperature, and to compare these findings with the behavior of lower strength metastable austenites which deform homogeneously and for which theoretical concepts are fairly well developed.

Author (GRA)

N78-19275# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEFORMED ALUMINUM ALLOY METALLOGRAPHY

3 Aug. 1977 392 p Transl. into ENGLISH of the book "Deformed Aluminum Alloy Metallography", Republic of China, 1975 p 1-224
(AD-A049264; FTD-ID(RS)T-0577-77) Avail: NTIS HC A17/MF A01 CSCL 11/6

This book places emphasis on phase formations and special features of eight principal alloy systems (including pure aluminum) of deformed aluminum alloys, the effects of various working methods (e.g. extrusion, rolling, forging, cold-drawing, etc.) on the alloy structures, and the peculiarities and regularities of alloy structures under various kinds of heat treatments (e.g. homogenization, annealing, quenching, ageing, etc.). Diagrams and accompanying explanations are generally included for the illustration of typical cases. GRA

N78-19276# Cambridge Univ. (England). Dept. of Engineering.

FRACTURE-MECHANISM MAPS FOR PURE IRON AND TWO STAINLESS STEELS Annual Report, Oct. 1976 - Oct. 1977

M. F. Ashby Oct. 1977 46 p refs
(Grant DA-ERO-76-G-060)
(AD-A049294) Avail: NTIS HC A03/MF A01 CSCL 11/6

The mechanisms of fracture of round tensile specimens of pure iron and of type 304 and 316 stainless steel have been studied. These new observations have been combined with a large body of published observation and used to construct two sorts of fracture mechanism maps, which summarize the behavior. Author (GRA)

N78-19277# Connecticut Univ., Storrs. Dept. of Metallurgy.

FATIGUE CRACK PROPAGATION IN TITANIUM ALLOYS Annual Report, 1 Jul. 1976 - 30 Sep. 1977

A. J. McEvily Nov. 1977 8 p refs
(Grant AF-AFOSR-2703-74)
(AD-A049200; UC-MET-5-1977; AFOSR-77-1305TR) Avail: NTIS HC A02/MF A01 CSCL 11/6

This Annual Report covers the period Aug. 1, 1976 through Sept. 30, 1977, and deals with the topics fatigue crack initiation and growth in Ti-6Al-4V forging alloy. Subsurface crack initiation has been related to the presence of severe dislocation pile-ups and perhaps to the influence of internal hydrogen. In the fatigue crack growth progress it has been shown that different mechanisms are operative in various regions of the da/dN versus delta K plot. The retardation effect associated with overload has been shown to be primarily a surface related effect due to the higher degree of crack closure which exists in the surface regions of a specimen. Author (GRA)

N78-19278# Naval Ship Research and Development Center, Bethesda, Md.

PROPERTIES OF COMBINED BEAM AND PLATE FOR HIGH-STRENGTH STEELS AND TITANIUM

Stephen F. Zemanek and Natale S. Nappi Dec. 1977 391 p refs
(SF43422593)
(AD-A048989; DTNSRDC-77-0069) Avail: NTIS HC A17/MF A01 CSCL 11/6

Design information is given to provide ship structural designers with convenient tabulations of the properties of built-up T-beams for the following high-strength materials: HY-80, HY-100, HY-130, and Ti 6Al-4V extra low interstitial. The T-beams are arranged in order of increasing sectional area for each material. Criteria for proportioning the T-beams are included in this report. The unit system used in the tables is English. No attempt has been made to convert to metric units at this time since the majority of structural designs are still done in English units.

Author (GRA)

N78-19279# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.

EROSIVE EFFECTS OF VARIOUS PURE AND COMBUSTION-GENERATED GASES ON METALS, PART 2 Final Report, 1 Jun. 1975 - 31 Jan. 1976

A. C. Alkidas, S. O. Morris, C. W. Christoe, L. H. Caveny, and M. Summerfield Oct. 1977 126 p refs
(Contract DAAG46-75-C-0088)
(AD-A048977; AMS-1303-Pt-2; AMMRC-CTR-77-25) Avail: NTIS HC A07/MF A01 CSCL 11/6

This study continues the experimental investigation of the thermal and chemical erosion characteristics of steel alloys which were begun under Contract DAAG46-72-C-0078. The high pressure (approx. 3 kbars) and high temperature (approx. 3000 K) environment to which the steel specimens are subjected is produced by a ballistic compressor and by a solid propellant combustor. Equilibrium thermochemical calculations of the possible reactions indicate that the most probable reaction products are oxides, nitrides, carbides, and carbonyls, in that order. The cause of surface cracks was found to be thermal and not relatable to the degree and severity of erosion. Erosion tests of the pure metals used as alloying elements revealed that molybdenum has the highest erosion resistance, followed by nickel. There is no evidence that alloying elements alter the chemical interaction between oxygen and iron. SEM studies revealed that when an accumulation of oxide scale occurs with successive firings, oxidation and thermal protection is provided. It is hypothesized that as long as steel remains below its solidus temperature, the primary erosion mechanism is the reaction of combustion gases with the steel surface to form scales and the subsequent carrying-away of the scales by the high speed flow.

GRA

N78-19280# Combustion Engineering, Inc., Chattanooga, Tenn.

DEVELOPMENT OF A 9 Cr STEEL WITH IMPROVED

STRENGTH AND TOUGHNESS
G. C. Bodine, Jr., B. Chakravarti, S. D. Harkness, C. M. Owens, B. Roberts, R. Vandergriff, and C. T. Ward 1977 8 p Presented at the Brit. Nucl. Energy Soc. Conf. on Ferritic Steels for Fast Reactor Steam Generators, London, 30 May 1977
(Contract W-7405-eng-26)
(CONF-770545-2) Avail: NTIS HC A02/MF A01

A development program was initiated to provide an alternate code approved advanced ferritic alloy for liquid metal fast breeder reactor (LMFBR) use. Laboratory heats were made of the type 9Cr-1Mo-Nb-V-W. In elevated temperature properties the experimental alloys are superior to code approved and candidate commercial steels. Improvements realized in weldability, toughness, and elevated temperature strength and stability are discussed. ERA

N78-19281# Oak Ridge National Lab., Tenn.
BEHAVIOR OF ANNEALED TYPE 316 STAINLESS STEEL UNDER MONOTONIC AND CYCLIC BIAXIAL LOADING AT ROOM TEMPERATURE
J. R. Ellis and D. N. Robinson 1977 17 p refs Presented at the 5th Intern. Conf. on Structural Mech. in Reactor Technol., San Francisco, 15 Aug. 1977
(Contract W-7405-eng-26)
(CONF-770807-26) Avail: NTIS HC A02/MF A01

The elastic-plastic behavior of type 316 stainless steel at room temperature was studied. The stress limited loading was restricted to two relatively simple histories, and since hardening under cyclic conditions is a concern in design, the yield behavior of type 316 stainless steel after several cycles of stain limited loading was investigated. ERA

N78-19282# Rensselaer Polytechnic Inst., Troy, N. Y.
INFLUENCE OF HYDROGEN ON HIGH CYCLE FATIGUE OF POLYCRYSTALLINE VANADIUM
D. W. Chung, K. S. Lee, and N. S. Stoloff Feb. 1977 10 p refs Presented at 2nd Intern. Congr. on Hydrogen in Metals, Paris, Jun. 1977
(Contract EY-76-S-02-3459)
(COO-3459-13; Conf-770613-3) Avail: NTIS HC A02/MF A01

The room temperature fatigue behavior of several polycrystalline V-H2 alloys is described. Hydrogen extends the life of unnotched vanadium but has a deleterious effect in notched materials. Crack propagation data are correlated with tensile yield stress and cyclic strain hardening data. Author (ERA)

N78-19283# Brookhaven National Lab., Upton, N. Y.
INTERRELATIONS BETWEEN PHASE DIAGRAMS AND HYDRIDING PROPERTIES FOR ALLOYS BASED ON THE INTERMETALLIC COMPOUND FeTi+
G. D. Sandrock (Intern. Nickel Co., Inc., Suffern, N. Y.), J. J. Reilly, and J. R. Johnson 6 Jan. 1977 26 p refs Presented at Workshop on Appl. of Phase Diagrams in Metallurgy and Ceram., Gaithersburg, Md., 10-12 Jan. 1977
(Contract EY-76-C-02-0016)
(BNL-22308; Conf-770116-4; Paper-959-T-OP) Avail: NTIS HC A03/MF A01

The interrelations among composition, microstructure, and hydriding behavior that can be related to phase diagram information were discussed. In particular the Fe-Ti, Fe-Ti-O, and Fe-Ti-Mn phase diagrams and their relationships to hydriding properties. The use of hydriding data to infer metal hydrogen phase diagrams was briefly discussed. ERA

N78-19284# Oak Ridge National Lab., Tenn.
STUDIES OF CALIFORNIUM METAL AT HIGH PRESSURE BY X-RAY DIFFRACTION
John H. Burns and J. R. Peterson 1977 6 p refs Presented at Intern. Conf. on Rare Earths and Actinides, Durham, Engl., 4-6 Jul. 1977
(Contract W-7405-eng-26)
(CONF-770717-1) Avail: NTIS HC A02/MF A01

The behavior of the crystal structure of californium metal under various pressures up to 140 kbars was studied by use of a diamond-anvil type of miniature X-ray diffraction camera. Ten-microgram samples were encapsulated in aluminum foil, which also served as an internal standard for pressure determination. The phase transitions in cerium metal were produced and identified as a test of the apparatus and technique. Californium metal samples in the low-density face-centered cubic form and in the high-density face-centered cubic form were each subjected to high pressure, but no transition was observed from one phase to the other. On release of the pressure, the lattice constant returned to its original value. Approximate values of the compressibility were obtained; they are about equal at 7 x 10 to the -7th power sq cm/kg. ERA

N78-19285# Los Alamos Scientific Lab., N. Mex.
REVIEW OF SOME PAST AND PRESENT POWDER METALLURGY PROGRAMS AT THE LOS ALAMOS SCIENTIFIC LABORATORY
H. Sheinberg Jul. 1977 18 p refs
(Contract W-7405-eng-36)
(LA-6862-MS) Avail: NTIS HC A02/MF A01

A new process is described for molding and extruding complicated shapes of uranium loaded graphite to close tolerances for use in nuclear propulsion engines. The process for hot pressing copper boron carbide and forming it into sheet for use as neutronic control material for these engines is also described. Fabrication procedure and deformation testing of carbide graphite composites for fuel element supports are outlined, as is the procedure for fabricating tungsten thoria heat shields for these reactors. Details are given for production of uranium carbide zirconium carbide solid-solution powder and fabrication of this powder and molybdenum uranium oxide powder into fuel pins for thermionic reactors. Methods and details are given for spheroidization of lithium deuteride to be used as laser fusion targets and for quality upgrading and characterization of micron size balloons for that use. ERA

N78-19286# Hanford Engineering Development Lab., Richland, Wash.
TEMPERATURE DEPENDENCE OF IN-REACTOR CREEP OF 20% COLD WORKED 316 STAINLESS STEEL
E. R. Gilbert and A. J. Lovell 1977 13 p refs Presented at the Intern. Conf. on Radiation Effects in Breeder Reactor Structural Mater., Scottsdale, Ariz., 19-23 Jun. 1977
(Contract EY-76-C-14-2170)
(HEDL-SA-1187; Conf-770641-10) Avail: NTIS HC A02/MF A01

In-reactor creep experiments were performed on two heats of 20 percent cold worked Type 316 stainless steel at temperatures ranging from 380 to 720 C. At low temperatures, irradiation creep dominated the deformation process and higher creep rates were observed in-reactor than out-of-reactor. At higher temperatures, thermal creep was dominating and in-reactor creep strains were found to be below the levels measured in pre- and postirradiation creep tests. Irradiation creep strains were generally found to increase with increasing temperatures in both the irradiation and thermal creep domain, except for temperatures near the domain boundary where the two deformation processes are of equal importance. In this region, the creep strains increased with increasing temperature, passed through a maximum, and went through a minimum near the domain boundary and subsequently increased with increasing temperature. ERA

N78-19287# Arizona Univ., Tucson. Optical Sciences Center.
OPTICAL AND ELECTRICAL EXPERIMENTS AT SOME TRANSITION-METAL OXIDE FOIL-ELECTROLYTE INTERFACES
S. O. Sari and W. L. Ahlgren 1977 23 p refs Presented at 4th Conf. on Surface Properties; Surface Sci., Rolla, Mo., 1 Aug. 1977 Sponsored in part by NSF
(Contract EG-77-S-02-4381)
(COO-4381-1; Conf-770833-1) Avail: NTIS HC A02/MF A01

Metaloxide layers formed from transition metal foils oxidized by heating in air were examined for their photoelectrolytic response. The metals examined were, Y, Ti, Zr, Hf, V, Nb, Ta, Mo, W, and Pt. Weak photoeffects were observed for oxide layers of all of these metals. Sizable light dependent oxygen gas evolution rates are found in Ti and also in W oxides. The spectral dependence of the oxygen response in these compounds was investigated, and interpretation was given of these experiments. ERA

N78-19288# Battelle Pacific Northwest Labs., Richland, Wash.
HIGH TEMPERATURE PROPERTIES OF ZIRCALOY-OXYGEN ALLOYS
G. B. Mellinger and J. L. Bates Mar. 1977 218 p refs
(Contract EY-76-C-06-1830; EPRI Proj. 251-1)
(EPRI-NP-524) Avail: NTIS HC A10/MF A01

The effect of oxygen on three properties of Zircaloy 4 cladding relevant to loss of coolant accident evaluation codes were determined. Thermal expansion, elastic moduli, and thermal diffusivity were measured over the range room temperature-1200 C and 0.7 to 28 at.% oxygen. Thermal expansion and elastic moduli showed increases with oxygen concentration, while thermal diffusivity tended to decrease. Zircaloy 2 was examined over the same temperature range, but only to 5 at.% oxygen. The thermal emittance of Zircaloy 4 was measured in argon over the wavelength range 1.5 to 2.5 microns on previously oxidized tubing and on surfaces in the process of oxidizing in unlimited steam. For the latter, a high emittance was reached at an oxide thickness of about 100 mg/sq dm, and the tubing surface remained black and substoichiometric as oxidation continued at temperatures to 1200 C. ERA

N78-19289# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy and Materials Science.
EXPERIMENTS IN HIGH VOLTAGE ELECTRON MICROSCOPY Progress Report, 31 Oct. 1976 - Aug. 1977
T. E. Mitchell, L. W. Hobbs, D. G. Howitt, R. Barnard, and H. Ro Jul. 1977 14 p refs
(Contract EY-76-S-02-2119)
(COO-2119-19) Avail: NTIS HC A02/MF A01

High voltage electron microscopy was used to study the effects of irradiation on a variety of materials. Threshold displacement energies were determined for a number of metals and for various oxides. In MgO, E/sub d/ was less along (100) than (110); also, E/sub d/ decreases with increasing temperature, possibly due to thermally activated escape of interstitials from recombination volumes or softening of saddle points. The effects of electron irradiation on precipitation in Al-Cu, Al-Si and Ni-Al alloys were investigated. In oxides, damage gives rise to interstitial dislocation loop nucleation and growth in all cases, perfect [110] loops in MgO fauited basal and prismatic loops in Al2O3. ERA

N78-19290# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
FACTORS CONTROLLING NITRATE CRACKING OF MILD STEEL
James A. Donovan 1977 15 p refs Presented at Conf. on Environ. Degradation of Eng. Mater., Blacksburg, Va., 10-13 Oct. 1977
(Contract EY-76-C-09-0001)
(DP-MS-77-53; Conf-771010-4) Avail: NTIS HC A02/MF A01

Crack growth measurements showed that sufficient concentrations of nitrite and hydroxide ions can prevent crack growth. Insufficient concentrations of these ions did not influence the stage 2 growth rate or the threshold stress intensity, but extended the initiation time. Stage 3 growth was discontinuous. Oxide formed in the grain boundaries ahead of the crack tip and oxide dissolution and fracture were the proposed mechanisms of nitrate stress corrosion crack growth. Author

N78-19291# Oak Ridge Y-12 Plantt, Tenn. Development Div.
EVALUATION OF SINTERED IRON FOR NEDS Final Report
W. G. Northcutt, Jr. 29 Jun. 1977 54 p
(Contract W-7405-eng-26)
(Y/DA-7330) Avail: NTIS HC A04/MF A01

Sintered liners for the NEDS container were produced by the pressing and sintering of 40 mesh iron powder. A 50% porous structure is the baseline design, and the density level is achieved by cold isostatic pressing at 27.6 MPa followed by sintering in a neutral or reducing atmosphere at 1000 C for 1 to 3 hours. The resulting produce can be handled and can be machined. The evaluation of the material was reported.
Author (ERA)

N78-19292# Ames Lab., Iowa.
ABSOLUTE LINEAR EXPANSIVITIES FOR SILICON, COPPER, AND ALUMINUM FROM 10 K TO 340 K
C. A. Swenson 1977 15 p refs Presented at the 7th Symp. on Thermophysical Properties, Gaithersburg, Md., 10 May 1977 Prepared jointly with Iowa State Univ., Ames
(Contract W-7405-eng-82)
(IS-M-98; Conf-770537-10) Avail: NTIS HC A02/MF A01

An absolute capacitance dilatometer was used to determine the linear thermal expansivities for high purity copper, aluminum and silicon from below 10 K to above room temperature. The accuracy of the results for the lowest expansion material, silicon, varied from 10 to the -10th power 1/k at low temperature to 10 to the -9th power 1/k or 0.1 percent from 77 K to 340 K. These data coincide with high quality room temperature results to better than 0.2 percent, and appear to be more smooth than published data at lower temperatures. The copper and aluminum results showed systematic deviations of up to 0.4 percent from previous precision data between 77 K and 300 K, although the agreement was 0.2 percent at room temperature. Each of these substances would appear to be useable as a thermal expansion reference standard over a wide range of temperature, with silicon having the greatest utility. ERA

N78-19293# Sandia Labs., Albuquerque, N. Mex.
ANALYSIS OF ELEVATED TEMPERATURE CYCLIC DEFORMATION OF AUSTENITIC STAINLESS STEELS
R. W. Rohde and J. C. Swearengen 1977 25 p refs Presented at 4th Intern. Conf. on Structural Mech. in Reactor Technol., San Francisco, 15 Aug. 1977
(Contract EY-76-C-04-0789)
(SAND-76-5888C; Conf-770807-17) Avail: NTIS HC A02/MF A01

The stress relaxation behavior of 304 and 316 stainless steels during cyclic deformation at 538 and 650 C with various hold times and strain amplitudes was analyzed in terms of a power law equation of state which includes internal stress and drag stress as structural variables. At 650 C the internal stress in 304 appears to be zero and microstructural recovery plays an important role in the kinetics of stress relaxation. For deformation at 538 C, the internal stress in 304 is nonzero and microstructural recovery appears minimal. In 316 tested at 650 C the internal stress is zero and again recovery is important. However, the kinetics of recovery differ from those measured in 304. These observations were explained physically in terms of strain and temperature induced recovery of the structural variables, and provided insights into the procedures for calculating accumulated creep damage in reactor components. ERA

N78-19294# Atlantic Richfield Hanford Co., Richland, Wash.
FEASIBILITY OF APPLYING CATHODIC PROTECTION TO DOUBLE-WALL WASTE STORAGE TANKS
E. L. Moore 1 Jun. 1977 32 p refs
(Contract EY-76-C-06-2130)
(ARH-CD-975) Avail: NTIS HC A03/MF A01

A study was conducted to determine the feasibility of applying impressed current cathodic protection to double-wall storage tanks containing terminal waste solutions. It was concluded that such a system could be designed for installation on the tanks. A laboratory study was conducted to develop necessary data for design of the system. A separate study indicated that, while terminal waste solutions by themselves do not promote stress corrosion cracking, cathodic protection may promote this type of corrosion under certain conditions. As a result of these findings, the recommendation was made not to install cathodic protection on the double-wall tanks containing terminal waste solutions. ERA

N78-19295# Brown Univ., Providence, R. I. Dept. of Engineering.
COMBINED MACROSCOPIC AND MICROSCOPIC APPROACH TO THE FRACTURE OF METALS Technical Progress Report, Jul. 1976 - Jun. 1977
J. Gurland, J. R. Rice, R. J. Asaro, and A. Needleman Jul. 1977 21 p
(Contract EY-76-S-02-3084)
(COO-3084-53) Avail: NTIS HC A02/MF A01

The contributions of dislocation substructures and local

stresses at particle interfaces to the strain hardening of dispersion hardened steels is discussed, and the model of segregant induced embrittlement of grain interfaces is presented. Work was continued on crack initiation at inclusions and on the theory of plastic flow localization. These microscopic effects are discussed in relation to the mechanisms of brittle fracture and ductile rupture of metals and alloys. Stress and strain associated with the large plastic deformation at a crack tip was further defined based on finite element and slip line calculations, and some preliminary results were obtained by finite element methods for stable crack growth under plane strain conditions. A new finite element method has been developed for fully plastic flow under plane strain conditions. ERA

N78-19296# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
DEFORMATION PROCESSES IN REFRACTORY METALS
L. P. Beckerman, F. J. M. Boratto, P. G. Watson, and R. E. Reed-Hill 1977 119 p refs
(Contract EY-76-S-05-3262)
(ORO-3262-54) Avail: NTIS HC A06/MF A01

Yield point return studies were conducted on alloys of niobium containing both oxygen and hydrogen. It was observed that hydrogen has a complex effect on both the kinetics and energies of the oxygen yield point return in niobium. Work in the area of slow strain rate embrittlement of oxygen by niobium and its relation to dynamic strain aging is described, along with data that has been obtained for the diffusion of oxygen and nitrogen in tantalum. They compliment similar data already published on the diffusion of oxygen and nitrogen in both niobium and vanadium. Finally, a report of the effects of hydrogen on both slow strain rate embrittlement and dynamic strain aging in vanadium is presented. Because the embrittling effect of hydrogen can seriously reduce the tensile ductility it is not possible to study most aspects of dynamic strain aging using tension tests. Compression tests on the other hand do not suffer from this problem. ERA

N78-19297# Georgia Univ., Athens. Dept. of Chemistry.
TRANSITION METAL CHEMISTRY UNDER HIGH CARBON MONOXIDE PRESSURE: AN INFRARED SPECTROSCOPIC STUDY OF CATALYSIS IN THE FISCHER-TROPSCH REACTION
R. B. King, A. D. King, Jr., M. Z. Iqbal, and C. C. Frazier Jan. 1977 14 p refs
(Contract E(38-1)-933)
(SRO-933-1) Avail: NTIS HC A02/MF A01

Equipment was designed to investigate the infrared spectra of metal carbonyl derivatives in the 1600 to 2200 mm nu(CO) region at pressures up to 500 atmospheres and temperatures up to 250 C. This equipment was used to study the infrared spectra of a variety of transition metal derivatives at elevated pressures of carbon monoxide. The ultimate objective is the development of new systems which are catalytically active for the conversion of mixtures of carbon monoxide and hydrogen to hydrocarbons in connection with the conversion of coal to hydrocarbon fuels. A high pressure infrared cell has been designed, constructed, and used for the preliminary investigations of reactions of about 15 transition metal derivatives under elevated pressure of carbon monoxide and hydrogen. ERA

N78-19298# Tennessee Technological Univ., Cookeville.
THERMAL CONDUCTIVITY, ELECTRICAL RESISTIVITY AND SEEBECK COEFFICIENT OF HIGH PURITY IRON AND SELECTED IRON ALLOYS FROM 90 K TO 400 K M.S. Thesis
T. K. Holder 31 Mar. 1978 98 p refs
(TID-27707) Avail: NTIS HC A05/MF A01

Smoothed values for the thermal conductivity and electrical resistivity were used to calculate the electronic thermal conductivity, the lattice conductivity, and the Lorenz function by means of a binary alloy separation technique. High purity iron, two iron chromium alloys, one iron nickel alloy, and one iron chromium nickel alloy were measured over the temperature range from 90 K to 400 K. The lattice conductivity and Lorenz function exhibited little change due to the addition of chromium; however, the addition of small amounts of nickel resulted in significant property changes. The lattice conductivity at high temperatures was calculated from theory and compared to experimental results. Good agreement between theory and experimental data was obtained. ERA

N78-19299# California Univ., Livermore. Lawrence Livermore Lab.
THERMAL EXPANSION OF METALS OVER THE ENTIRE LIQUID RANGE
J. W. Shaner 25 Aug. 1977 14 p refs Presented at Intern. Thermal Expansion Symp., Winnipeg, Canada
(Contract W-7405-eng-48)
(UCRL-80007; Conf-770843-3) Avail: NTIS HC A02/MF A01

Techniques for the measurement of liquid metal densities are discussed. Maximum bubble technique, pycnometry, and the Archimedian method are among those presented for temperatures below 2000 K, as well as techniques for more extreme temperatures. Author

N78-19300# Oak Ridge National Lab., Tenn.
SUBSTRUCTURES DEVELOPED DURING CREEP AND CYCLIC TESTS OF TYPE 304 STAINLESS STEEL (HEAT 9T2796)
R. W. Swindeman, R. K. Bhargava, V. K. Sikka, and J. Moteff Sep. 1977 36 p
(Contract W-7405-eng-26)
(ORNL-5293) Avail: NTIS HC A03/MF A01

Data include dislocation densities, cell and subgrain sizes, and carbide precipitate sizes. Testing conditions range for temperatures from 482 to 649 C, for stresses from 28 to 241 MPa, and for times from 4 to 15,000 hr. As expected, it was observed that temperature, stress, and time have strong influences on substructure. The change in the dislocation density was too small to measure for conditions, which produce less than 1 percent monotonic strain. No cells formed, and the major alteration of substructure was the precipitation of M23C6 carbides on grain boundaries, on twin boundaries, and on some dislocations. At stresses ranging from 69 to 172 MPa and at temperatures ranging from 482 to 593 C, the dislocation density increases with increasing stress and is generally higher than expected from studies made at higher temperatures. Dislocations are arranged in fine networks stabilized by carbides. At stresses above 172 MPa and temperatures to 649 C, the dislocation density is too great to measure. ERA

N78-19301# Argonne National Lab., Ill.
IRRADIATION-INDUCED CREEP IN 316 AND 304L STAINLESS STEELS
L. C. Walters, G. L. McVay, and G. D. Hudman 1977 20 p refs Presented at the Conf. on Radiation Effects in Breeder Reactor Structural Mater., Scottsdale, Ariz., 19-23 Jun. 1977
(Contract W-31-109-eng-38)
(CONF-770641-3) Avail: NTIS HC A02/MF A01

The experiments consist of four subassemblies that contain helium-pressurized as well as unstressed capsules of 316 and 304L stainless steels in several metallurgical conditions. The accumulated neutron dose on the 304L capsules at 385 C was 45 dpa; on the 316 capsules at 400 C, 40 dpa; and on the 316 capsules at 550 C, 25 dpa. It was found that the inreactor creep rates were linearly dependent on hoop stress, with the exception being capsules of 316 stainless steel that had been given long-term carbide aging treatment and then irradiated at 550 C. Those capsules exhibited much higher creep and swelling rates than their unaged counterparts. For the metallurgical conditions where significant swelling was observed it was found that the in-reactor creep rates were readily fit to a model that related the creep rates to accumulated swelling. Additionally, it was found that the stress-normalized creep rate for 20%-cold-worked 316 stainless steel at a temperature of 550 C was 1.6 times that observed at 400 C. ERA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N78-19302* National Aeronautics and Space Administration. Pasadena Office, Calif.

HIGH TEMPERATURE RESISTANT CERMET AND CERAMIC COMPOSITIONS Patent

Wayne M. Phillips, inventor (to NASA) (JPL) Issued 7 Feb. 1978 10 p Filed 20 Nov. 1975 Supersedes N76-13294 (14 - 04, p 0433) Sponsored by NASA
(NASA-Case-NPO-13690-1; US-Patent-4,072,532; US-Patent-Appl-SN-633876; US-Patent-Class-106-65; US-Patent-Class-106-39.5; US-Patent-Class-106-73.5) Avail: US Patent Office CSCL 11B

High temperature oxidation resistance, high hardness and high abrasion and wear resistance are properties of cermet compositions particularly to provide high temperature resistant refractory coatings on metal substrates, for use as electrical insulation seals for thermionic converters. The compositions comprise a sintered body of particles of a high temperature resistant metal or metal alloy, preferably molybdenum or tungsten particles, dispersed in and bonded to a solid solution formed of aluminum oxide and silicon nitride, and particularly a ternary solid solution formed of a mixture of aluminum oxide, silicon nitride and aluminum nitride. Ceramic compositions comprising a sintered solid solution of aluminum oxide, silicon nitride and aluminum nitride are also described.

Official Gazette of the U.S. Patent Office

N78-19303*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TOUGHENING OF GRAPHITE-EPOXY COMPOSITES BY INTERLAMINAR PERFORATED MYLAR FILMS

Wolf Elber Mar. 1978 16 p refs
(NASA-TM-78643; L-11462) Avail: NTIS HC A02/MF A01 CSCL 11G

Fracture and notch strength tests of graphite-epoxy composites showed that unidirectional lay-ups generally exhibit longitudinal cracking before failure, whereas multidirectional lay-ups fail transversely with little longitudinal cracking. A simple qualitative analysis suggested that the higher matrix shear stresses in unidirectional materials cause the longitudinal cracking, and that this cracking was responsible for the high toughness of unidirectional composites. In a series of comparative tests, the interlaminar strength of multi-directional composites was reduced by placing perforated Mylar films between laminae; tests on notched and slotted specimens showed that the interlaminar films promoted delamination and longitudinal cracking near the notches and that, as a result, toughness, notch strength, and impact strength were substantially increased. Author

N78-19304# California Univ., Berkeley. Dept. of Chemical Engineering.

SECONDARY RELAXATION BEHAVIOR OF SOME DIENE POLYMERS

Jacob Mathew, Mitchel Shen, and Thomas F. Schatzki (Western Regional Research Center, Berkeley, Calif.) 1 Sep. 1977 13 p refs
(Contract N00014-75-C-0955)
(AD-A048460; TR-16) Avail: NTIS HC A02/MF A01 CSCL 11/9

It has been found that below the glass transition temperature there are two distinct secondary loss peaks for the trans isomer of polybutadiene, but not for the cis isomer. The purpose of this work is to compare the dynamic mechanical loss curves of three polymers containing the diene groups in an effort to further scrutinize this interesting behavior. GRA

N78-19305# United Technologies Research Center, East Hartford, Conn.

DEVELOPMENT OF DIRECTIONALLY SOLIDIFIED EUTECTIC CERAMIC MATRIX-METAL COMPOSITES Final Report, Apr. 1976 - Apr. 1977

C. O. Hulse 1 May 1977 65 p refs
(Contract N62269-76-C-0250; WR02204001)
(AD-A048470; UTRC/R77-912587-4; NADC-75282-30) Avail: NTIS HC A04/MF A01 CSCL 11/4

The third and final year of effort to identify and develop directionally solidified ceramic matrix-metal eutectic composites for use uncoated at temperatures exceeding 1315 C (2400 F) in aircraft gas turbines is reported. The primary approach was to identify oxide-metal systems in which the metal whisker phase would form a self-protective oxide coating on exposure to air at elevated temperatures. Many different oxide-metal combinations were examined by melting prefired slugs contained tungsten wire baskets. The specimens were melted by radiation from a carbon susceptor inductively heated in argon. A wide range of cubic mixed oxides in combination with high-melting pure metal candidates were examined. A number of compositions were found which solidified as regular oxide-metal eutectics but difficulties with container reactivities and with the volatility of certain components prevented the fabrication of ingot samples suitable for further evaluation. Although the possibility remains that suitable eutectic systems may exist, the general conclusion from this work is that chances for the successful development of an oxide-metal eutectic system for structural use uncoated in air at elevated temperatures should now be considerably reduced. Author (GRA)

N78-19306# Vought Corp., Dallas, Tex.

OPTIMIZATION OF PROCESSING VARIABLES WHICH AFFECT ADHESION OF ORGANIC COATINGS Final Report, 26 Apr. 1976 - 25 Jun. 1977

A. B. Featherston and G. W. Kelly Jun. 1977 49 p refs
(Contract N00019-76-C-0358; N00019-75-C-0087)
(AD-A048467; Rept-2-37100/7R-3390) Avail: NTIS HC A03/MF A01 CSCL 11/3

This report describes the results obtained in a study program to optimize surface preparation and application of organic coatings on non-metallic composites and to develop adhesion data on additional aluminum alloys following an optimized anodizing process. This study also describes development of adhesion data on additional aluminum alloys following an optimized chemical conversion coating processes. The Blister Test Method was utilized for generation of all adhesion data obtained in this study. The concluding segment of this study describes optimization of chemical conversion coating processing parameters to obtain reliable adhesion characteristics within practical processing tolerances and investigation of more rapid test methods of measuring resistance of aluminum alloys to corrosion.

Author (GRA)

N78-19307# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.

THE ROLE OF LUBRICANT TYPE AND SUBSTRATE COMPOSITION IN THERMALLY INDUCED OIL MIGRATION Interim Report

Alfred A. Fote and Robert A. Slade 6 Dec. 1977 14 p refs
(Contract F04701-77-C-0078)
(AD-A048716; TR-0078(3970-30)-1; SAMSO-TR-77-219) Avail: NTIS HC A02/MF A01 CSCL 11/8

The dependence of thermally induced oil migration on substrate composition and lubricant type has been investigated. It was found that, unless dewetting occurs, the substrate composition does not affect the rate of migration. It was also verified that oils other than Apiezon C undergo thermally induced oil migration. These results agree with the predictions of our theoretical model. Finally, the relative stability of grease films to temperature gradients of the same magnitude was demonstrated. Author (GRA)

N78-19308# Rockwell International Corp., Thousand Oaks, Calif. Science Center.

ACOUSTIC SURFACE WAVE SCATTERING: THE DETECTION OF SURFACE CRACKS IN CERAMICS Technical Report, 1 Nov. 1976 - 30 Nov. 1977

B. T. Khuri-Yakub (Stanford Univ., Calif.), A. G. Evans, G. S. Kino (Stanford Univ., Calif.), and B. R. Tittmann 20 Dec. 1977 44 p refs
(Contract N00014-76-C-0854)
(AD-A049181; SC5064.2TR) Avail: NTIS HC A03/MF A01 CSCL 11/2

An acoustic surface wave technique for detecting surface cracks in ceramics has been devised. The technique has been demonstrated to detect individual cracks at least as small as 60 micrometers in depth, with the detectability limit for individual cracks being imposed by the size distribution of the adjacent background cracks. The attenuation of the surface wave has also been attributed (at least in structural ceramics) to the surface

cracks, and preliminary correlations between attenuation and the large extremes of the crack size distribution have been reported.
Author (GRA)

N78-19309# National Bureau of Standards, Washington, D. C.
PIEZO- AND PYROELECTRICITY OF POLY(VINYLIDENE FLUORIDE) FROM PLASMA POLING
John E. McKinney and G. Thomas Davis 1 Dec. 1977 14 p refs
(Contract N00014-78-F-0015)
(AD-A048903; TR-7) Avail: NTIS HC A02/MF A01 CSCL 20/9

A plasma poling device is described which allows essentially instantaneous poling of polymeric films at room temperature at very high fields. Using poly(vinylidene fluoride) both undrawn (comprising essentially pure alpha conformation) and biaxially drawn (both alpha and beta conformation) were polarized in this manner. The polarization of the sample was determined from current integration measurements. The piezoelectric and pyroelectric coefficients were then measured and compared with those estimated from the polarization theory of Mopsik and Broadhurst, which expresses these coefficients as linear functions of polarization. The theory gives an accurate representation of the piezoelectric coefficients, but underestimates the pyroelectric coefficients considerably.
GRA

N78-19310# National Bureau of Standards, Washington, D. C.
DETERMINATION OF CHARGE OR POLARIZATION DISTRIBUTION ACROSS POLYMER ELECTRETS BY THE THERMAL PULSE METHOD AND FOURIER ANALYSIS
A. S. Dereggi, C. M. Guttman, F. I. Mopsik, G. T. Davis, and M. G. Broadhurst Sep. 1977 18 p refs
(Contract N00014-78-F-0015)
(AD-A048902; TR-6) Avail: NTIS HC A02/MF A01 CSCL 20/3

Fourier analysis, applied to the recently introduced thermal pulse method, yields new and unique relations between the time-dependent, pyroelectric response of a thin specimen and the Fourier coefficients of the charge or polarization distribution across its thickness. The new analysis is applied illustratively to thermal pulse data for a vinylidene fluoride copolymer electret.
Author (GRA)

N78-19311# California Univ., Los Angeles. Dept. of Chemistry.
SYNTHESIS OF ELECTRON-DEFICIENT BIFERRACARBORANES
C. G. Salentine and M. F. Hawthorne 10 Jan. 1978 21 p refs Submitted for publication
(Contract N00014-76-C-0390)
(AD-A048973; TR-98) Avail: NTIS HC A02/MF A01 CSCL 07/3

The polyhedral expansion of 3.1.2-C5H5FeC2B9H11 produced three new electron-deficient biferracarboranes (C5H5Fe)2C2B9H11, (C5H5Fe)2C2B8H9(OH) and (C5H5FeC2B9H11FeC2B9H11)(-). All three complexes contained formal Fe(III) atoms and were diamagnetic. The proposed structures, based on spectroscopic and crystallographic data, contain non-bonded iron atoms. These complexes constitute the first examples of long-range electron-spin coupling through a carborane polyhedron.
Author (GRA)

N78-19312# State Univ. of New York, Plattsburgh. Dept. of Chemistry.
LOW FREQUENCY DIELECTRIC RESPONSE OF AN ORGANOARSENIC POLYMER (CH3As)x
John E. Lewis and Arnold L. Rheingold 1 Jan. 1978 29 p refs
(Contract N00014-75-C-0798)
(AD-A049226; TR-10) Avail: NTIS HC A03/MF A01 CSCL 20/3

The dielectric relaxation behavior of bis(catena-poly (methylarsenic)), (CH3As)(x) at excitation frequencies below 10 Hz is highly anomalous, varying as omega to the -9th. This behavior is examined in terms of Jonscher's 'universal' dielectric response.
Author (GRA)

N78-19313# National Materials Advisory Board, Washington, D. C.
ORGANIC POLYMER CHARACTERIZATION Final Report
1977 154 p refs
(Contract MDA903-74-C-0167)
(AD-A049338; NMAB-332) Avail: NTIS HC A08/MF A01 CSCL 11/9

This report attempts to define those properties of organic polymers that are critical to their use in current and advanced structural applications. It discusses and evaluates the characterization methodology that is available to measure and control those properties. It suggests some specific areas in which this technology can be employed to achieve improved performance and reliability through its application to procurement and quality control procedures. Case studies are presented to illustrate the utilization of characterization. Conclusions and recommendations are presented. A list of more than a hundred useful methods of characterization with committee commentary on use and limitations is given in an appendix.
Author (GRA)

N78-19314# Naval Research Lab., Washington, D. C.
ADDITIVE REACTIONS IN HIGH TEMPERATURE DEPOSITION TESTS Interim Report
H. Ravner Nov. 1977 17 p
(AD-A049114; AD-E000061; NRL-MR-3644) Avail: NTIS HC A02/MF A01 CSCL 11/8

The preliminary phase of a joint NRL/NAPTC study of additive depletion in an ester-based formulation has been concluded; a high-temperature deposition tester was employed as the test system under both aeration and nitrogen blanket conditions. An expression relating induction times and original concentrations of two amine inhibitors was devised based on simple kinetics of an inhibited system.
Author (GRA)

N78-19315# McDonnell-Douglas Research Labs., St. Louis, Mo.
STUDY OF THE CLASS TRANSITION IN CROSSLINKED POLYMERS USING NUCLEAR AND ELECTRON MAGNETIC RESONANCE Final Report, 6 Sep. 1976 - 6 Dec. 1977
I. M. Brown and A. C. Lind 6 Dec. 1977 88 p refs
(Contract N00019-76-C-0565)
(AD-A048981; MDC-Q0633) Avail: NTIS HC A05/MF A01 CSCL 07/3

Pulsed and CW electron paramagnetic resonance (EPR) and pulsed proton nuclear magnetic resonance (NMR) techniques were applied to the study of the main-chain segmental motions associated with the glass transitions in block copolymers and the influence of plasticizers on these motions. In the EPR experiments, both CW and electron spin echo measurements were made of a stable nitroxide radical which was used as an EPR spin probe of its environment in the block copolymer. The proton NMR experiments included conventional spin-lattice and spin-spin relaxation time measurements along with broadline and multiple-pulsed partially-relaxed spectra. Samples of polydimethylsiloxane (DMS) and bisphenol-A polycarbonate (BPAC) of varying composition and block length were examined. Above 220 K, the radicals exhibited both broadline and narrowline EPR spectra indicating the coexistence of two phases wherein the radical can undergo either slow motions (the slow phase) or fast motions (the fast phase). The NMR experiments were capable of distinguishing motional activity as a function of proton position along the block. Both the EPR and NMR results indicated that main-chain segmental motion at the center of the DMS blocks exceeded that at the ends and propagated outward along the block as the temperature increased. The temperature dependence of the ratios of (1) the number of radicals in the fast phase to the number in the slow phase and (2) the protons in the rubbery phase to those in the rigid phase agreed qualitatively with this model.
GRA

N78-19316# State Univ. of New York, Plattsburgh. Dept. of Chemistry.
SEMICONDUCTIVITY IN ORGANOARSENIC MATERIALS Final Report, 1 Apr. 1973 - 28 Feb. 1977
A. L. Rheingold and J. E. Lewis Dec. 1977 16 p refs
(Contract N00014-75-C-0798)
(AD-A049336) Avail: NTIS HC A02/MF A01 CSCL 07/2

A general investigation of the macromolecule formation abilities of the hypothetical monomeric unit, RE, where R is an

organic group and E either arsenic or antimony, resulted in the development of several novel crystalline materials possessing unique structural and electrical properties. Technical reports, publications, and oral presentations are tabulated. Author (GRA)

N78-19317# California Univ., Berkeley. Lawrence Berkeley Lab.
MECHANICAL PROPERTIES OF DIRECTIONALLY SOLIDIFIED Al-Si EUTECTIC M.S. Thesis
D. G. Morrow May 1977 34 p refs
(Contract W-7405-eng-48)
(LBL-6036) Avail: NTIS HC A03/MF A01

The effect of directional solidification on the yield strength of the Al-Si eutectic alloy was studied. Eutectic alloys (Al-12.7 wt. % Si) were directionally frozen at growth rates, R, between 0.0097 cm/h and 47.0 cm/h through a temperature gradient of about 80 C/cm. An oriented [001]] Si fiber texture is obtained for rates less than 1.0 cm/hr, and at higher growth rates microstructures similar to the as-cast eutectic are found. At the lower growth rates, banded structures alternating rich in Si and lean in Si were also observed. Tensile measurements indicated that the yield strength is independent of R at growth rates less than ca. 1.0 cm/h, while at higher growth rates the strength increases linearly with R/sup 1/4/. Composite strngthening due to aligned Si microstructure at low R was not exhibited due to the preferential yielding within the banded structures. Yield strengths for higher growth rates are controlled by a precipitate spacing effect. ERA

N78-19318# Lehigh Univ., Bethlehem, Pa.
PRESSURE SINTERING AND CREEP DEFORMATION: A JOINT MODELING APPROACH Progress Report, 1 Jan. - 31 Dec. 1977
M. R. Notis Jul. 1977 12 p refs
(Contract EY-76-S-02-2408)
(COO-2408-4) Avail: NTIS HC A02/MF A01

The joint modeling of creep deformation and pressure sintering was refined to include a transition stage that accounts for a decreasing connectivity for the cylindrical-open porosity and a smooth transition to spherical porosity as pinch off occurs. This transition stage takes into account three major contributions to densification, lattice diffusional flow, grain boundary flow, and power law deformation. Work was continued on creep studies of NiO and CoO, comparing the similarities and differences in creep behavior and relating these to dislocation structures observed in TEM. Finally, work was completed on the grain growth of CoO as a function of porosity level, and also the effects of impurities on the creep and densification rates of CoO and NiO. These studies have provided specific information required for the intermediate stage modeling. ERA

N78-19319# Case Western Reserve Univ., Cleveland, Ohio.
COUPLED DIFFUSION PHENOMENA IN MULTICOMPONENT GLASSES AND GLASS FORMING LIQUIDS Progress Report, 1 Sep. 1976 - 1 Jun. 1977
A. R. Cooper Jun. 1977 33 p refs
(Contract EY-76-S-02-4075)
(COO-4075-1) Avail: NTIS HC A03/MF A01

Oxygen self diffusion coefficients in the multicomponent K2O-SrO-SiO2 glass have been determined. The D values are several orders of magnitude lower than those for Sr and K. The low activation energy and low D sub 0 for oxygen are indicative of diffusion due to a quenched in defect. To describe such a defect may involve the possibility of a topological description for defects in amorphous lattices. A method that avoids the problem of thermal convection has been developed and samples have been prepared for self diffusion studies in molten K2O-SrO-SiO2. ERA

N78-19320# Sandia Labs., Albuquerque, N. Mex.
STRESS EFFECTS IN FERROELECTRIC CERAMICS
I. J. Fritz and J. D. Keck 1977 15 p refs Presented at the 6th AIRAPT Intern. High-Pressure Conf., Boulder, Colo., 25 Jul. 1977
(Contract EY-76-C-04-0789)
(SAND-77-0066C; Conf-770706-11) Avail: NTIS HC A02/MF A01

The typical behavior observed for ferroelectric ceramics under different conditions of high stress and field is presented. In particular, the observation of domain reorientation effects and of pressure and field enforced phase transitions are emphasized. ERA

N78-19321# Sandia Labs., Albuquerque, N. Mex. Surface Metallurgy Div.
COATING OF METALS WITH TITANIUM DIBORIDE BY CHEMICAL VAPOR DEPOSITION
H. O. Pierson and E. Randich 1977 19 p refs Presented at the 6th Intern. Conf. on Chem. Vapor Deposition, Atlanta, 10 Oct. 1977
(Contract EY-76-C-04-0789)
(SAND-77-0363C; Conf-771004-3) Avail: NTIS HC A02/MF A01

The chemical vapor deposition of titanium diboride on metallic substrates by the hydrogen reduction of TiCl4 and BCl3 at temperatures between 850 C and 1100 C was experimentally investigated. Kovar, tantalum, and several stainless steels were found to be suitable substrates since they could withstand the deposition temperature, and they had adequate resistance to HCl, a by-product of the deposition reaction, and had thermal expansion coefficients sufficiently close to that of TiB2. The TiB2 coatings produced were 68.2 percent Ti and thus near stoichiometry and had very low impurity content. They had Knoop hardnesses averaging 3300 kg/sq mm and exhibited extraordinary erosion resistance. ERA

N78-19322# California Univ., Livermore. Lawrence Livermore Lab.
HYDRODYNAMIC MODELING AND EXPLOSIVE COMPACTION OF CERAMICS
C. Hoenig, A. Holt, M. Finger, and W. Kuhl 1 Sep. 1977 15 p refs Presented at 6th Intern. Conf. on High Energy Rate Fabrication, Essen, 9-16 Sep. 1977 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-79345; Conf-770938-1) Avail: NTIS HC A02/MF A01

High-density ceramics with high-strength microstructure were achieved by explosive compaction in both cylindrical and flat plate geometries. Microhardness measurements indicated that the strength and integrity of the microstructure were comparable to conventionally fabricated ceramics, even though all samples with densities greater than 90 percent theoretical contained macrocracks. Fractured surfaces evaluated by SEM showed evidence of boundary melting. Calculations show that very little melting can be expected in samples shocked to less than 3 GPa. Significant melting and grain boundary fusion can be expected in samples shocked to pressures greater than 8 GPa. Hydrodynamic modeling of right cylinder compaction with detonation at one end was attempted by using a two-dimensional computer code. ERA

N78-19323# Battelle Pacific Northwest Labs., Richland, Wash. Ceramics and Graphite Section.
NEUTRON IRRADIATION EFFECTS ON CARBON AND GRAPHITE CLOTHS AND FIBERS
W. J. Gray Aug. 1977 51 p refs
(Contract EY-76-C-06-1830)
(BNWL-2390) Avail: NTIS HC A04/MF A01

A series of cloth and 10 x fiber samples were irradiated to fluences of 3.5, 7.3, and 10 x 10 to the 21st power 1/cm squared at 470 C. Dimensional changes of the fibers in the radial direction ranged from -19 percent to +33 percent and in the axial direction from -18 percent to -27 percent, roughly ten times greater than dimensional changes found for typical nuclear graphites. Despite these large dimensional changes, all but one of the two dimensional cloths remained essentially unchanged in overall physical appearance. The three dimensional cloths, on the other hand, deteriorated apparently because these types of weaves were less able to accommodate the large axial fiber shrinkages. ERA

N78-19324# Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Research Group.
EFFECT OF HEAT ON FLEXING FATIGUE IN A GLASS FIBER FILTER CLOTH
S. T. R. Wilkins Aug. 1977 25 p refs

(PB-274581/8; CSIR-CENG-204; ISBN-0-7988-1188-9) Avail: NTIS HC A02/MF A01 CSCL 13K

Over the last decade the flexing endurance of glass fibre filter cloth for high-temperature gas filtration has been improved by a factor of roughly 10. The flexing life of samples measured after exposure to heat (288 C) decreases within 30 minutes of exposure to about 1/3 of the unexposed value with a subsequent gradual recovery to about half of that value. After approximately 100 hours of exposure deterioration becomes marked and after 1000 hours deterioration is fast. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N78-19325*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

JET AIRCRAFT HYDROCARBON FUELS TECHNOLOGY

John P. Longwell, ed. 1978 64 p Workshop held at Cleveland, Ohio, 7-9 Jun. 1977

(NASA-CP-2033; E-9457) Avail: NTIS HC A04/MF A01 CSCL 21D

A broad specification, referee fuel was proposed for research and development. This fuel has a lower, closely specified hydrogen content and higher final boiling point and freezing point than ASTM Jet A. The workshop recommended various priority items for fuel research and development. Key items include prediction of tradeoffs among fuel refining, distribution, and aircraft operating costs; combustor liner temperature and emissions studies; and practical simulator investigations of the effect of high freezing point and low thermal stability fuels on aircraft fuel systems. Author

N78-19326*# Gordian Associates, Inc., New York.

COMPUTER MODEL FOR REFINERY OPERATIONS WITH EMPHASIS ON JET FUEL PRODUCTION. VOLUME 2: DATA AND TECHNICAL BASES Final Report

Daniel N. Dunbar and Barry G. Tunnah 21 Feb. 1978 55 p refs

(Contract NAS3-20620)

(NASA-CR-135334; Rept-1099-1) Avail: NTIS HC A04/MF A01 CSCL 21D

The FORTRAN computing program predicts the flow streams and material, energy, and economic balances of a typical petroleum refinery, with particular emphasis on production of aviation turbine fuel of varying end point and hydrogen content specifications. The program has provision for shale oil and coal oil in addition to petroleum crudes. A case study feature permits dependent cases to be run for parametric or optimization studies by input of only the variables which are changed from the base case. The report has sufficient detail for the information of most readers. Author

N78-19327# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.

VERIFICATION OF CONTAMINATION PREDICTIONS FOR MONOPROPELLANT THRUSTERS Final Report, Sep. 1975 - Oct. 1977

Larry P. Davis and Steven G. Wax Oct. 1977 57 p refs

(AD-A049048; AFRPL-TR-77-56) Avail: NTIS HC A04/MF A01 CSCL 21/8

This paper represents the major results and conclusions of an AFRPL in-house analysis program set up to verify the capabilities of the monopropellant option of the CONTAM computer code for predicting plume contamination on sensitive spacecraft surfaces. The data used for verification was acquired in an AFRPL sponsored program at JPL. In that program, quartz crystal microbalance surfaces were used to measure the net deposition rate from the plume of a 0.1 lbf hydrazine thruster operating at vacuum conditions. The CONTAM code was used to model the 0.1 lbf thruster and to calculate the net deposition rates measured in the JPL tests. A comparison of the results indicated that the CONTAM code, while predicting the correct trends, overpredicts the plume mass deposition rates. Possible explanations for this deviation as well as a discussion of future studies to further understand the model's limitations are presented. Author (GRA)

N78-19328# Naval Weapons Support Center, Crane, Ind.

SPECTRAL ANALYSIS OF PYROTECHNIC HCl EMISSIONS Interim Report, Jun. 1975 - Nov. 1976

Carl E. Dinerman 30 Sep. 1977 21 p refs

(WR022402002)

(AD-A049150; NWSC/CR/RDTR-71) Avail: NTIS HC A02/MF A01 CSCL 19/1

In HCl-producing pyrotechnic flames, the effective flame temperature experimentally determined from HCl infrared spectral analysis (1-0 vibration-rotation emission band) was approximately 1780 K, compared with 1900-1950 K derived theoretically. For another, more fuel rich composition, approximately 1620 K was experimentally derived, compared with 1800-2250 K theoretically, assuming 0-10% air admixture, and remaining near 2250 K for higher percentages. Author (GRA)

N78-19329# Stanford Research Inst., Menlo Park, Calif.

STUDIES OF HOMOGENEOUS AND HETEROGENEOUS HYDRAZINE DECOMPOSITION FOR MONOPROPELLANT PROPULSION SYSTEMS Final Report, 1 Jun. 1976 - 30 Sep. 1977

A. C. Baldwin, D. M. Golden, K. E. Lewis, R. T. Rewick, and H. Wise 31 Oct. 1977 48 p refs

(Contract F44620-73-C-0069)

(AD-A049340) Avail: NTIS HC A03/MF A01 CSCL 21/8

The properties of alumina-supported Ir-Ni alloy catalysts for the decomposition of hydrazine have been examined over a range of mixed-metal compositions. The results demonstrate that the addition of Ni to Ir increases the specific catalytic activity, with a maximum at 35 atomic percent Ni, and at the same time reduces the decay in activity caused by the accumulation of reaction products over a range of Ni-Ir alloy compositions. Author (GRA)

N78-19330# Sandia Labs., Albuquerque, N. Mex.

STUDY OF RAISED BRIDGEWIRES IN A PYROTECHNIC DEVICE

W. B. Leslie and R. W. Dietzel Jul. 1977 27 p refs

(Contract EY-76-C-04-0789)

(SAND-76-0725) Avail: NTIS HC A03/MF A01

Experiments were conducted with raised bridgewires to try to demonstrate that they will give more reliable ignition. The test units were heated to 185 F for five hours, then cooled to -85 F for three hours, and the cycle repeated an additional six times. Following the thermal shock test, the units were exposed to a mechanical shock of 1500 g at ambient temperature. Each unit received a nondestructive Electrothermal Response Test (ETR) after fabrication and after each of the two environmental tests. The ETR tests showed that the thermal contact between the bridgewire and the powder was not degraded after exposure to the two environments. Each unit was ignited by an electrical pulse while being maintained at a low temperature. Each unit ignited and gave a satisfactory output. It was concluded that a thin layer of powder around the bridgewire is sufficient to render any wall effect negligible and that the principle of the raised bridgewire in contact with TIHO.65-KC104 is worthy of further study. ERA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N78-19331 California Univ., Berkeley.

NONLINEAR ANALYSIS OF REINFORCED CONCRETE PANELS, SLABS AND SHELLS FOR TIME-DEPENDENT EFFECTS Ph.D. Thesis

Ahmad Fazlul Kabir 1977 246 p

Avail: Univ. Microfilms Order No. 77-31415

A numerical method of analysis was developed to trace the

quasistatic responses of various types of reinforced concrete structures, of practical interest, under sustained load conditions. Time-dependent environmental phenomena, such as creep and shrinkage effects, were considered to obtain the evolution of the field variables of such structures in elastic and inelastic regimes. Ultimate collapses of shear panels, slabs of arbitrary geometry and free-form shell-type structures were then predicted considering local failures in steel and concrete along with the deterioration of structural stiffness due to progressive cracking. A finite element tangent stiffness formulation, coupled with a time step integration scheme was developed to analyze the reinforced concrete systems. Dissert. Abstr.

N78-19332 Texas A&M Univ., College Station.
THERMAL ANALYSIS PROCEDURE FOR BUILDING COMPONENTS USING COMPUTER GENERATED CLIMATIC FACTORS Ph.D. Thesis
Donald Warren Barnes, Jr. 1977 136 p
Avail: Univ. Microfilms Order No. 7732223

The development of a consumer booklet that architects, engineers or other interested people can use to accurately forecast the energy used for heating and cooling a residence is documented. Each booklet, when published, will include four computer generated tables which combine weather data for a specific city with general building thermal characteristics. The narrative section of the booklet contains step by step instructions on how to use these tables for making a complete thermal analysis of a residence or for merely comparing two thermal options. The tables are generated by two computer programs. This record of study explains the development of the program and the algorithms used, and includes a FORTRAN IV computer listing of the two programs. Dissert. Abstr.

N78-19333*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SELECTED US BUILDING INDUSTRY PROCESSES AND CHARACTERISTICS. A PROJECT SAGE REPORT
R. Barbieri and R. Schoen Jan. 1978 68 p Sponsored in part by Southern California Gas Co.
(Contract NAS7-100; Grant NSF PTP-75-03457)
(NASA-CR-155943; JPL-Pub-77-48) Avail: NTIS HC A04/MF A01 CSCL 13B

Selected multifamily processes were examined using a primarily graphic approach to clarify some of the operational modes into which Project SAGE (solar-assisted gas energy) must fit, both as a product and a process in the U.S. building industry. What SAGE must have or do in order to fit the building industry in the short term, that is, the multifamily submarket as it is presently configured, is delineated. Author

N78-19334# Purdue Research Foundation, Lafayette, Ind. Div. of Sponsored Research.
NONCONTRACT NONDESTRUCTIVE DETERMINATION OF PAVEMENT DEFLECTION UNDER MOVING LOADS Final Report, Dec. 1974 - Dec. 1976
M. E. Harr and N. T. Ng-A-Qui Aug. 1977 327 p refs Prepared in cooperation with AFSC
(Contract DOT-FA-73WAI-361)
(AD-A047161/5; FAA-RD-77-127) Avail: NTIS HC A15/MF A01 CSCL 13/2

Transfer function theory was used to form the basis of a pavement evaluation and response scheme. Two mobile systems were developed for the measurement of pavement deflections; the Light Emitting Diode system and the Linear Variable Differential Transformer system. The rapid nondestructive measurement of pavement deflections due to moving prototype loads is feasible and a total nondestructive evaluation scheme based entirely on the use of prototype loads and measured deflections can be fabricated to evaluate and predict instantaneous response and cumulative effects of loads of various magnitudes and configurations. Author

N78-19335*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FIXED-BASE AND TWO-BODY EQUATIONS OF MOTION FOR AN ANNULAR MOMENTUM CONTROL DEVICE (AMCD)
Nelson J. Groom Mar. 1978 27 p refs
(NASA-TM-78644) Avail: NTIS HC A03/MF A01 CSCL 20K

Fixed base and two body equations of motion for an Annular Momentum Control Device (AMCD) are presented. An AMCD consists of a spinning annular rim which is suspended by noncontacting magnetic bearings and powered by a noncontacting linear electromagnetic motor. The fixed base equations are for a rigid AMCD rim suspended by magnetic bearings attached to a rigid fixed base. The two body equations are for a rigid AMCD rim suspended by magnetic bearings attached to a rigid body spacecraft. The fixed base equations are applicable to any potential ground based AMCD application such as energy storage. Author

N78-19336# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF UNSTEADY SUPERCAVITATING HYDROFOILS OF FINITE SPAN Final Report, Oct. 1976 - Sep. 1977
Chen-Wen Jiang and Patrick Leehey Sep. 1977 134 p refs
(Contract N00014-76-C-0358)
(AD-A048626; Rept-83481-4) Avail: NTIS HC A07/MF A01 CSCL 20/4

Measurements of the forces, moment and cavity pressure on aspect ratio 3 and 5 supercavitating hydrofoils of elliptical planform oscillating in pitch have been obtained at frequencies from 5 to 20 Hz. A region of resonant behavior was found, which corresponds to a natural frequency of the cavity. A thermodynamic analysis of the cavity was performed under the assumptions of a spherical cavity and uniform cavity interior properties. The calculated damped natural frequencies were compared with the results taken from peak oscillatory lift experiments. The damping ratio of the cavity depends upon the partial pressure of air, temperature and cavity size. A numerical method was developed for a supercavitating hydrofoil. The problem of supercavitating hydrofoils of finite span in steady flow was solved numerically and compared with analytical solutions and with experiments. Results of these calculations indicate that this method gave a more accurate prediction of lift and moment coefficients than existing asymptotic theories. The numerical solutions of unsteady hydrofoils of finite span were also compared with experiments. The amplitude of the forces was in good agreement, but the phase differences between theory and experiment was large. GRA

N78-19337# Rockwell International Corp., Anaheim, Calif. Autonetics Group.
SYSTEMATIC MEASUREMENT ERRORS
Rolf B. F. Schumacher 1977 14 p refs
(AD-A048809; X77-1125/101) Avail: NTIS HC A02/MF A01 CSCL 14/2

Nature, origin, and treatment of systematic errors in measurements and calibrations are discussed. It is shown how systematic errors can vary, how random errors under one set of conditions will become systematic errors under another set of conditions and vice versa. Recommendations are made concerning the assignment of values to limits of systematic errors of measurements and standards. Author (GRA)

N78-19338# California Univ., Livermore. Lawrence Livermore Lab.
TORNADO STRUCTURE INTERACTION: A NUMERICAL SIMULATION
Tim Wilson 20 May 1977 90 p refs
(Contract W-7405-eng-48)
(UCRL-52207) Avail: NTIS HC A05/MF A01

The American National Standards Institute (ANSI) has developed guidelines for building code requirements for the minimum wind loads a building must be designed to withstand. The conservation or nonconservation on the ANSI approach was evaluated by simulating tornado structure interaction numerically with a two-dimensional fluid dynamics computer code and a vortex model. Only external pressures were considered. The computer calculations yield the following percentages of the ANSI design pressures: rigid frame, 50 to 90 percent; individual wall panels, 75 to 200 percent; and wall corners, 50 to 75 percent. ERA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N78-19339 California Univ., Berkeley.
ON ELECTROMAGNETIC WAVE SCATTERINGS BY BURIED OBSTACLES Ph.D. Thesis
Shu-Kong Chang 1977 157 p
Avail: Univ. Microfilms Order No. 7731314

The scatterings of electromagnetic waves by buried obstacles are solved by using the unimoment method. This investigation has made the solution possible by: (1) Generalizing the Sommerfled's integrals. (2) Developing a fast converging multipole base fields, each of which satisfies the air-ground boundary condition. This thesis has shown that the vertical cylindrical vector potentials compensated by a pair of horizontal circularly polarized vector potentials should result in a much faster converging base field. Numerical results are presented for scattering by buried perfectly conducting and dielectric spheres. The results are checked three ways, namely (1) by the boundary conditions of the air-ground interface, (2) by the scattering from a pseudosphere and (3) by the reciprocity theorem, all indicating the approach to be sound and the results accurate.
Dissert. Abstr.

N78-19340 Ohio Univ., Athens.
IMAGE PROCESSING BY HYBRID CODING (TRANSFORM-DPCM AND DPCM-TRANSFORM) TECHNIQUES Ph.D. Thesis
Quyen Dan Hua 1977 244 p
Avail: Univ. Microfilms Order No. 7732233

Transform-DPCM and DPCM-transform hybrid coding techniques which combine one-dimensional DPCM and transform processes are analyzed using total mean-square-error as the measure of fidelity. In the hybrid coding schemes the DPCM process is used to decorrelate the image in one direction and the transform process in the remaining direction. Error formulas are obtained for both hybrid coding systems, including the effects of noisy channel, using the two-dimensional stationary Gaussian Markov source. Closed-form expressions of channel errors are obtained for the natural binary code and the folded binary code in terms of the probability of bit errors. The results indicated the superior performance of the folded binary code for a stationary Gaussian Markov input in a noisy channel. Hybrid coding techniques are used to process six aerial reconnaissance-type photographs. Results are presented for various error criteria and for bit rates of 0.25, 0.5, 1.0 and 1.5 bits per pixel.
Dissert. Abstr.

N78-19341 Syracuse Univ., N. Y.
GENERALIZED WALSH FUNCTIONS: THEORY AND APPLICATIONS IN DIGITAL SYSTEMS Ph.D. Thesis
James Juh Liu 1977 137 p
Avail: Univ. Microfilms Order No. 77-30740

By defining a generalized dyadic multiplication and a generalized Gray code, Walsh functions are generalized to include nonintegral orders. A dyadic differentiation is defined which is compatible with Walsh functions and generalized Walsh transformations. Walsh transform method is used to determine the response of discrete dyadic-invariant systems, and a fast dyadic convolution scheme is devised which requires fewer operations than that required for direct computation when the input signal and the system response are given in the time domain. An approach for the matrix representation of nonlinear elements and for solving nonlinear differential equations is formulated and found to yield steady-state solutions in a straightforward manner. The effect of channel noise in a binary transmission system is analyzed. Systematic procedures for both the bipolar encoder and the natural encoder cases are developed. Dissert. Abstr.

N78-19342 Massachusetts Univ., Amherst.
PULSE TRANSMISSION OVER THE FADING IONOSPHERIC REFLECTION CHANNEL Ph.D. Thesis
Alfonso Malaga 1977 185 p
Avail: Univ. Microfilms Order No. 77-30563

The modeling of the HF ionospheric reflection communications channel and application of the model to study the distortion mechanisms which affect the transmission of pulses used in digital data transmission were considered. The propagation medium was characterized by a time-invariant transfer function. Results which illustrate the dependence of the transfer function on both the deterministic and random spatial and temporal variations of the tropospheric refractive index and the electron density in the ionosphere, transmitter-receiver separation, time of the day and operating frequency are given. In addition, the frequency and time-selective fading characteristics of the HF link caused by multiple scatter phenomena are related to the statistical spatial characteristics of the refractive index of the propagation medium. Dissert. Abstr.

N78-19343 Pennsylvania Univ., Philadelphia.
DETECTION OF QUASI PERIODIC ARRIVAL TIME SEQUENCES Ph.D. Thesis
Stephen Joseph Rosasco 1977 321 p
Avail: Univ. Microfilms Order No. 77-30245

The effectiveness of utilizing only the Pulse Repetition Interval (PRI) characteristics of a signal class to implement the detection process was studied. The observables available to the PRI processor was taken to be the arrival times of all pulses received by the system. Each member of the signal class was modelled as a set of arrivals having a nominal PRI T, with each interarrival period a random variable dependent on two stochastic mechanisms. The interference received by the processor was modelled as a constant intensity Poisson arrival process. Probability density functions of the arrival times received by the processor for the interference only hypothesis and interference pulse signal hypothesis were formulated, and the processor structure was derived by forming the likelihood ratio of these density functions. Dissert. Abstr.

N78-19344 Polytechnic Inst. of New York.
EQUALIZATION IN DATA TRANSMISSION SYSTEMS Ph.D. Thesis
Miroslaw Wernicki 1977 198 p
Avail: Univ. Microfilms Order No. 7721097

Some problems associated with equalization of data transmission systems of the pulse amplitude modulated (PAM) type are presented. To suppress the impulsive noise while increasing the influence of intersymbol interference insignificantly, two classes of nonlinearities are considered. The performance of these nonlinearities in mixture distribution noise is studied using mean square error and signal to noise ratio as criteria of optimality. The equalizer structure is analyzed and designed using distributed parameter and digital filters. The effect the nonlinearities have on the intersymbol interference are investigated. The conditions under which the boundedness of the intersymbol interference can be guaranteed are determined. The total receiver structure is investigated with a special stress on two aspects of system optimization. Dissert. Abstr.

N78-19345*# American Electronic Labs., Inc., Lansdale, Pa.
LOW COST MINIATURE DATA COLLECTION PLATFORM
Apr. 1977 142 p refs
(Contract NAS5-22829)
(NASA-CR-156707; Rept-10173) Avail: NTIS HC A07/MF A01 CSCL 17B

The development of the RF elements of a telecommunications package involved detailed study and analysis of concepts and techniques followed by laboratory testing and evaluation of designs. The design goals for a complete telecommunications package excluding antenna were a total weight of 300 grams, in a total volume of 400 cu cm with a capability of unattended operation for a period of six months. Of utmost importance is extremely low cost when produced in lots of 10,000. Early in the program it became apparent that a single Miniature Data Collection Platform would not satisfy all users. A single high efficiency system would not satisfy a user who had available a large battery capacity but required a low cost system. Conversely, the low cost system would not satisfy the end user who had a very limited battery capacity. A system design to satisfy these varied requirements was implemented by designing several

versions of the system building blocks and then constructing three systems from these building blocks. Author

N78-19346*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BROAD PERSPECTIVES IN RADAR FOR OCEAN MEASUREMENTS
Atul Jain 15 Feb. 1978 34 p refs
(Contract NAS7-100)
(NASA-CR-155941; JPL-Pub-78-4) Avail: NTIS HC A03/MF A01 CSCL 17I

The various active radar implementation options available for the measurement functions of interest for the SEASAT follow-on missions were evaluated. These functions include surface feature imaging, surface pressure and vertical profile, atmospheric sounding, surface backscatter and wind speed determination, surface current location, wavelength spectra, sea surface topography, and ice/snow thickness. Some concepts for the Synthetic Aperture Imaging Radar were examined that may be useful in the design and selection of the implementation options for these missions. The applicability of these instruments for the VOIR mission was also kept under consideration. Author

N78-19347# Utah Univ., Salt Lake City. Dept. of Computer Science.
NOISE SUPPRESSION METHODS FOR ROBUST SPEECH PROCESSING Semiannual Technical Report, 1 Apr. - 30 Sep. 1977
Steven F. Boll Oct. 1977 127 p refs
(Contract N00173-77-C-0041; ARPA Order 3301)
(AD-A048633; UTEC-CSC-77-202) Avail: NTIS HC A07/MF A01 CSCL 17/2

Robust speech processing in practical operating environments requires effective environmental and processor noise suppression. This report describes the technical findings and accomplishments during this reporting period for the research program funded to develop real time, compressed speech analysis-synthesis algorithms whose performance is invariant under signal contamination. Fulfillment of this requirement is necessary to insure reliable secure compressed speech transmission within realistic military command and control environments. Overall contributions resulting from this research program include the understanding of how environmental noise degrades narrow band, coded speech, development of appropriate real time noise suppression algorithms, and development of speech parameter identification methods that consider signal contamination as a fundamental element in the estimation process. This report describes the current research and results in the areas noise suppression using the SABER algorithm, dual input adaptive noise cancellation using the LMS algorithm, pole-zero parameter estimation and multirate coding and CVSD simulation. Author (GRA)

N78-19348# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
ENVIRONMENT AND RADAR OPERATION SIMULATOR Final Report, 21 Jun. 1974 - 30 Mar. 1977
S. N. Cole, A. R. Clayton, E. R. Flynt, R. C. Michelson, and B. S. Rice Ft. Monmouth, N. J. ECOM Aug. 1977 59 p refs
(Contract DAAB07-74-C-0272; DA Proj. 1S7-62703-DH-93)
(AD-A048473; ECOM-74-0272-F) Avail: NTIS HC A04/MF A01 CSCL 17/9

This report summarizes activities performed under contract to the U. S. Army Electronics Command (ECOM) for the purpose of designing and building an Environment and Radar Operation Simulator (EROS). EROS is electrically connected to the subject radar and simulates the external world by producing synthetic backscatter from targets and clutter in a battlefield environment. Its purpose is to reduce the cost of environment testing by improving repeatability and controllability of test conditions and by replacing some of the field testing with laboratory testing. Clutter is synthesized by an array of digital filters, which provide controllable amplitude distributions, spatial distributions, and spectra. Targets are simulated by combining recorded backscatter with user-defined maneuvers. The major components of EROS are a programmed digital computer, special-purpose high speed digital hardware, and analog hardware. The outputs consist of simulated video signals and range-gated Doppler signals.
Author (GRA)

N78-19349# Virginia Polytechnic Inst. and State Univ., Blacksburg.
QUADRATIC MULTIPLEXING: A NEW METHOD FOR SECURE COMMUNICATION
Melvin J. Hinich Dec. 1977 16 p refs
(Contract N00014-75-C-0494; NR Proj. 042-315)
(AD-A048454; TR-11) Avail: NTIS HC A02/MF A01 CSCL 17/2

A secure digital multiplexing technique is presented which uses a pseudo-random process with a fundamental cycle length N. The method can handle D N signal sequences of length M - N. The SNR's of the de-multiplexed signals is N/4DM for large N, even if the additive noise power is large. The de-multiplexer must compute the discrete Fourier transform of the pseudo-random sequence that is used to encode the signals. Information is carried in the phase differences between the frequency components of the multiplexed signal. De-multiplexing requires at least DMNlog2N arithmetic calculations.
Author (GRA)

N78-19350# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
CHARACTERISTICS OF A 240 TO 400 MHz 4-INCH DEPTH RIDGES-CAVITY CROSS-SLOT ANTENNA ON A CURVED GROUND PLANE Final Report, Dec. 1973 - May 1974
J. L. Wong, H. E. King, and C. E. Ermatinger 20 Jan. 1977 30 p refs
(Contract F04701-77-C-0078)
(AD-A048717; TR-0078(3401-30)-1; SAMSO-TR-77-181)
Avail: NTIS HC A03/MF A01 CSCL 09/5

A cross-slot antenna backed by a 33-in. square x 4.18-in. deep ridged cavity is described for operation in the 240 to 400 MHz band. The antenna was developed for a potential flight test evaluation using a satellite-to-aircraft communication link. Measured VSWR, radiation patterns and gain with the antenna mounted on a 9.5 ft x 9.5 ft cylindrically curved ground plane are shown. This curved ground plane simulates a section of the fuselage of a KC-135 aircraft. Author (GRA)

N78-19351# IIT Research Inst., Chicago, Ill.
STEP POTENTIAL AND BODY CURRENT NEAR A BURIED HORIZONTAL BARE CONDUCTOR IN A TWO-LAYER EARTH
H. Shiau and M. F. Genge Dec. 1977 25 p refs
(Contract N00039-76-C-0141)
(AD-A048646; IITRI-E6357-7) Avail: NTIS HC A02/MF A01 CSCL 20/14

The problem of electrical safety in the vicinity of the Navy's proposed Seafarer antenna is studied. The electrostatic solutions for the step potential and earth resistance are derived for a two-layer earth model from which the body current is calculated. It has been found that under certain conditions the maximum body current predicted by a two-layer earth model is greater than that obtained from the uniform earth analysis.
Author (GRA)

N78-19352# Environmental Research Inst. of Michigan, Ann Arbor.
BISTATIC CLUTTER DATA MEASUREMENTS PROGRAM Final Technical Report, 1 Oct. 1975 - 30 Sep. 1976
R. W. Larson and R. C. Heimiller Griffiss AFB, N. Y. RADC Nov. 1977 360 p refs
(Contract F30602-76-C-0037; ARPA Order 3071)
(AD-A049037; ERIM-118200-14-F; RADC-TR-77-389) Avail: NTIS HC A16/MF A01 CSCL 17/9

Empirical data have been obtained from which estimates of the bistatic reflection coefficient, sigma sub 0, have been determined. Measurements were made on two terrain types; grassy terrain and an area of tall weeds and rough ground; at bistatic angles of 70, 75, 80, and 85 deg. low grazing angles and 0 to 180 deg. azimuth angle. The terrain was irradiated at wavelengths of 3 cm and 23 cm with horizontal polarization. Both like and orthogonal polarizations were received at each wavelength four channels of data were recorded. The measurement technique utilized an aircraft with the 3 cm and 23 cm transmitters on board the receivers were mounted on a tower. The transmissions were pulsed, and coherent signals were recorded by utilizing a separate air-to-ground link for the receiver local oscillator signal.

This report presents the design considerations of the experiment, the complete experimental results, the results of the data analysis as well as a detailed documentation of the instrumentation and the data analysis procedures. Author (GRA)

N78-19353# Office of Telecommunications, Boulder, Colo. Inst. for Telecommunication Sciences.

PRECIPITATION VARIABILITY IN THE USA FOR MICROWAVE TERRESTRIAL SYSTEM DESIGN

E. J. Dutton Nov. 1977 132 p refs Sponsored by Army
(AD-A049041; OT-77-134) Avail: NTIS MF A01 CSCL 17/2

A FORTRAN computer program, entitled PRED77, has been prepared to predict SHF microwave link degradation due to rain-caused attenuation in the United States of America. This program, which predicts 5, 50, and 95 percent confidence levels of rain-caused attenuation, is similar to one developed earlier for Europe. Major changes are in the prediction of rain rate climatology. A telecommunications-oriented rainfall climatological index is developed for the U.S.A., and 19 zones of similar rainfall characteristics are subsequently developed, using a 359-station data base. Contour maps of important input parameters that can be used to assess rain rate and its variance at a location via numerical methods in PRED77 are presented. These numerical methods are also discussed, as well as the limitations of these methods for large variances of the input parameters. As in earlier work for Europe, an interpolation scheme for obtaining otherwise unknown data at a location from the 359-station data base is included in PRED77. GRA

N78-19354# Naval Ocean Systems Center, San Diego, Calif.

HIGH-FREQUENCY INTERFERENCE SUPPRESSION. INTERFERENCE IS IDENTIFIED AND THEN ELIMINATED Research and Development Technical Report, Aug. 1976 - Aug. 1977

Gary J. Brown 8 Aug. 1977 107 p
(XF21222091)
(AD-A049138; NOSC/TR-155) Avail: NTIS HC A06/MF A01 CSCL 17/2

This report investigates techniques for suppressing interferences that occur on a communication channel, specifically the high-frequency radio channel. The interferences are divided into 2 categories, those that occupy a narrow bandwidth with respect to the communicator's signal and those that occupy a bandwidth approximately equal to or greater than the communicator's bandwidth. The processing techniques which are examined are based upon using large time-bandwidth product (TW) signals, where TW is much larger than the symbol alphabet size, whereby large portions of the symbol TW space can be altered or totally eliminated while still maintaining quality communication due to the symbol coding redundancy. The suppression problem is divided into two areas; first, the identification of the interference and, second, its elimination. A simple threshold algorithm (called the quantile algorithm) is used for identification where a level is set based on one point of the exceedance function over the ensemble of the time-envelope samples (for broadband interference in the time domain) or the magnitude of frequency samples (for narrowband interference in the frequency domain). The suppression techniques investigated include excising (setting to zero) samples that exceed the threshold level, clipping at the threshold level, and a logarithmic weighting of samples. Simulations were used to evaluate various techniques and it was found that with only one type of interference present, the simple quantile algorithm and excision processing worked well for either narrowband or broadband interference. GRA

N78-19355# Weather Wing (3rd), Offutt AFB, Nebr.

SHORT WAVE FADEOUT (SWF) EQUIPMENT AND OPERATIONAL PROCEDURES

Kenneth E. Eis 15 Jan. 1977 21 p refs
(AD-A048963; Rept-3WW-TN-78-1) Avail: NTIS HC A02/MF A01 CSCL 20/14

This Technical Note explains the new AWS short wave fadeout (SWF) instrumentation, its installation, calibration and use. Details of SWF observation are discussed. This paper can be used by local equipment technicians as a Technical Order (T.O.) on the SWF equipment until a formal T.O. exists. Author (GRA)

N78-19356# Army Missile Research and Development Command, Redstone Arsenal, Ala. Test and Evaluation Directorate.

CALIBRATION AND USE OF B DOT PROBES FOR ELECTROMAGNETIC MEASURING

George R. Edlin, Wayne T. Hudson, and Thomas H. Shumpert 9 Aug. 1977 62 p refs
(AD-A048878; DRDMI-ET-77-8) Avail: NTIS HC A04/MF A01 CSCL 14/2

Modern electromagnetic radiation testing techniques require accurately calibrated field probes that can operate over a wide range of frequencies, without adjustments. This requirement is an outgrowth of the use of wideband radio frequency amplifiers and computer-controlled swept frequency generators. The computer can control the field strength accurately only if accurate sensor information is continuously available. One type of sensor that fulfills this requirement is the b dot probe. The b dot probe is a matched 50-ohm multigap loop which measures db/dt according to Faraday's law. To assure the accuracy of the probes, a calibration against the National Bureau of Standards' standard dipoles is required. From this calibration data a polynomial is developed which when multiplied times the output of the probe in milliwatts will give the actual field strengths. The output of a digital power meter is fed into the computer which applies the calibration polynomial and allows a real-time electromagnetic field leveling to be accomplished. This technique is applicable any time broadband electromagnetic leveled field is required. This study also outlines the design and construction of a single-ended 50-ohm b dot probe, as well as the calibration and development of the required calibration polynomial for computer use. Author (GRA)

N78-19357# Air Force Geophysics Lab., Hanscom AFB, Mass. Meteorology Div.

MEASUREMENTS OF VISIBILITY AND RADAR REFLECTIVITY DURING SNOWSTORMS IN THE AFGL MESONET Environmental Research Papers, 1972-1976

H. Stuart Muench and H. Albert Brown 5 Jul. 1977 36 p refs
(AD-A049258; AFGL-TR-77-0148; AFGL-ERP-602) Avail: NTIS HC A03/MF A01 CSCL 17/9

Field experiments were conducted with the AFGL Mesonet and FPS-77 digital radar during snowstorms for evaluation of the use of radar to observe and predict snow. Simultaneous measurements of optical extinction coefficient, radar reflectivity, and snow depth were made, together with determinations of visual range. The measurements verify both the calibration of the visibility instruments and the relationship between visual range and extinction coefficient. A relationship found between extinction coefficient and snowfall rate compares well with relationships found by other investigators. Radar reflectivity is found to be related to extinction coefficient, with the correlation being improved by time averaging and by allowance for velocity of snowflakes from the radar beam to the ground. However, the specification errors are of the order of + or - 42 percent to + or - 65 percent, and with the small spatial and temporal variability of extinction coefficient in snow, the radar is of marginal use where observations are available from the airways network. Author (GRA)

N78-19358# Rome Air Development Center, Griffiss AFB, N.Y.

TOLERANCE ERRORS FOR VERY LOW SIDELOBE ANTENNAS

Ronald L. Fante Oct. 1977 20 p refs
(AD-A049259; RADC-TR-77-360) Avail: NTIS HC A02/MF A01 CSCL 09/1

We have calculated the surface tolerances necessary to achieve -50 dB sidelobes, with various probabilities, for a parabolic cylinder reflector antenna. Author (GRA)

N78-19359# Center for Naval Analyses, Arlington, Va. Systems Evaluation Group.

A RADAR DETECTION MODEL

Kerry Kirk Mar. 1977 72 p refs
(AD-A049261; CRC-321) Avail: NTIS HC A04/MF A01 CSCL 17/9

This paper presents a FORTRAN language radar detection model that determines the signal-to-noise (S/N) ratio as a function of target range. The model determines S/N ratios in a clear or

noise jamming environment. The jamming may be created by a self-screening or standoff jammer operating against the radar in the main-lobe and/or side-lobe. The threats may have an ascending, level, or descending flight profile. The effects of atmospheric attenuation, weather clutter, sea state, surface clutter, and multipath may also be considered. Author (GRA)

N78-19360# E-Systems, Inc., St. Petersburg, Fla. ECI Div.
TRANSMISSION SUBSYSTEM CONTROL ANALYSIS AND DEVELOPMENT Final Report, 28 Feb. - 15 Jul. 1977
Richard K. Smith and Jere N. Beauchamp 15 Jul. 1977 276 p refs
(Contract DCA100-76-C-0036)
(AD-A049225; AD-E100012) Avail: NTIS HC A13/MF A01 CSCL 17/2

This report represents the results of a study aimed at analyzing the needs and developing a concept for transmission control for the DCS Digital European Backbone (DEB) Network. Included in this report are considerations regarding operations concept, telemetry, data acquisition, processing, control and reporting. Author (GRA)

N78-19361# Illinois Univ. at Chicago Circle, Chicago. Communications Lab.
DIRECT AND INVERSE SCATTERING FROM PERFECTLY CONDUCTING OBJECTS Final Report
Piergiorgio L. E. Uslenghi Feb. 1977 24 p refs
(Grant AF-AFOSR-2263-72)
(AD-A049328; AFOSR-77-1299TR) Avail: NTIS HC A02/MF A01 CSCL 20/3

This report contains a summary of the research performed under Grant AFOSR 72-2263, with abstracts of ten referred papers, three scientific reports and seven symposia presentations. The research is concerned with electromagnetic radiation and scattering from conducting and dielectric objects. Author (GRA)

N78-19362# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
HIGH RESOLUTION, HIGH BRIGHTNESS COLOR TELEVISION PROJECTOR: ANALYSIS, INVESTIGATIONS, DESIGN, PERFORMANCE OF BASELINE PROJECTOR Final Report, Jul. 1976 - Mar. 1977
P. C. Baron, E. R. Charles, D. E. Sprotbery, and D. B. Jorgensen Sep. 1977 134 p ref
(Contract F33615-76-C-0040; AF Proj. 6114)
(AD-A049279; AFHRL-TR-77-33(1)) Avail: NTIS HC A07/MF A01 CSCL 14/2

This study addressed the problem of establishing the feasibility of, and defining, a high performance color television projector to be used in optically mosaicked, computer image generator (CIG) driven wide-field-of-view simulators. Based on verbal briefing, reviewing documentation, and a visit to the Advanced Simulator for Pilot Training (ASPT) at Williams AFB, the RFP requirements were interpreted, refined and prioritized. The survey task reviewed the extant state-of-the-art in display technology for techniques which held promise of meeting the RFP requirements. Based on this task, it was concluded that only the liquid crystal light valve (LCLV) technology had a chance to do so; however, its performance needed to be upgraded significantly from the then current state. A systematic investigation of all components contributing to projector operation was therefore undertaken. The lamp, illumination system, polarizing beamsplitter, dichroics, LCLVs, CRT, deflection system, projection lens and screen were all subjected to a systematic test/analysis cycle, and improvements were made as required. Samples were obtained, tested and analyzed; breadboards were built and tested; and detailed studies were conducted. Subcontract studies were let, to investigate the dichroics and the projection lens. The latter was a major effort by Kollmorgen Corp. Tradeoffs were generated relating brightness to color purity/range, light falloff to pilot head motion, and resolution to CRT spot size and projection lens cost. Components were then selected (or specified) to result in an RFP-compliant system which yielded minimum overall risk. The projector was defined in detail. GRA

N78-19363# Harry Diamond Labs., Adelphi, Md.
AN APPROXIMATE SOLUTION FOR THE RESPONSE OF A SPHERE IN A TACTICAL EMP SOURCE REGION AND ESTIMATES OF COUPLING TO AN ANTENNA
Monti R. Wilson Dec. 1977 33 p refs
(DA Proj. 1L1-62118-AH-75)
(AD-A049274; HDL-TM-77-34) Avail: NTIS HC A03/MF A01 CSCL 20/14

Bombardt (1975) has discussed an early time model for the electromagnetic response of a sphere over a guard plane in the presence of source and conduction currents in the air. In this report the formal field solutions from this model are approximately evaluated via contour integration of inverse Laplace transforms. The resulting scattered radial electric field is used to estimate the electromagnetic pulse response of a sphere-mounted antenna. Author (GRA)

N78-19364# Harris Corp., Melbourne, Fla. Electronic Systems Div.
ANALYSIS OF JITTER CHARACTERISTICS IN A PULSE STUFFING TDM NETWORK Final Report, Aug. 1976 - Jun. 1977
J. A. Gracia and Thomas G. Zogakis Jun. 1977 258 p refs
(Contract DCA100-76-C-0072)
(AD-A049310; AD-E100005) Avail: NTIS HC A12/MF A01 CSCL 17/2

The purpose of this study and breadboard development program was to provide an understanding of the performance of networks which utilize equipment employing pulse stuffing synchronization. The study was divided into two phases. Phase I covered (1) analytical investigations of jitter characteristics, (2) recommended jitter specification formulation, and (3) development of a breadboard testbed. Phase II covered testbed evaluation and experimentation. The Phase I study approach consisted of developing three tools to study the jitter problem: (1) mathematical models, (2) a software simulator, and (3) a breadboard testbed. In Phase II RMS and peak-to-peak jitter data were collected and analyzed for various system design parameter inputs. The output data of the test and evaluation phase were compared with the analysis simulation results. Descriptions of the analysis tools, experiments, and results for both phases are included in this report. Author (GRA)

N78-19365# Defense Communications Engineering Center, Reston, Va.
A MATHEMATICAL APPROACH TO DCS ARCHITECTURE FORMULATION
W. P. Dotson Sep. 1977 56 p refs
(AD-A049224; AD-E100017; DCEC-TN-18-77) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report develops a mathematical way of treating far-term DCS (e.g., DCS III) technical planning. The mathematical approach cannot solve all the problems, but it narrows the range of feasible alternatives. Thus, the methodology suggested is a management aid, not a replacement. With this approach, planning the DCS must be stated as an optimization problem. Therefore, high level planning issues and objectives must be translated into proximate and technically meaningful terms. When this is done, the solution can be sought. The report concludes with a proposed methodology and recommendations for implementation. Author (GRA)

N78-19366# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
THE APPLICATION OF MULTIPLE PROCESSOR COMPUTER SYSTEMS TO DIGITAL COMMUNICATION NETWORKS Final Report, May 1975 - Jun. 1976
Mario Barbacci, Lih Chang, Samuel Fuller, Ashok Ingle, Navindra Jain, John Oakley, and Daniel Siewiorek 28 Jun. 1976 154 p refs
(Contract DCA100-75-C-0066)
(AD-A049192; AD-E100014) Avail: NTIS HC A08/MF A01 CSCL 17/2

This report describes work done to define and implement an experimental facility that emulates the behavior of a single node in an integrated circuit-packet-switching communications network: (1) Identified the functional characteristics of the system, (2) Developed and implemented a task decomposition that performs the different functions of an integrated switch, (3) Developed theoretical switch performance models and (4) Developed a reliability study of the hardware components. GRA

N78-19367# Haskins Labs., New Haven, Conn.
SPEECH RESEARCH Status Report, 1 Jul. - 31 Dec. 1977
Arthur S. Abramson, Thomas Baer, Fredericka Bell-Berti, Gloria J. Borden, and Guy Carden 31 Dec. 1977 223 p refs
(Contracts MDA904-77-C-0157; PHS-HD-01994)
(AD-A049215; SR-51/52-1977) Avail: NTIS HC A10/MF A01 CSCL 06/16

This report is one of a series on the progress of studies on the nature of speech, instrumentation for its investigation, and practical applications. Manuscripts cover the following topics: Identification of Sine-wave Analogues of Speech Sounds; Prosodic Information for Vowel Identity; Progressive Changes in Articulatory Patterns in Verbal Apraxia; Temporal Coordination of Phonation and Articulation in a Case of Verbal Apraxia -- A voice onset time study; Factors in the Maintenance and Cessation of Voicing; Influence of Tempo on Stop Closure Duration as a Cue for Voicing and Place; Reading Reversals and Dyslexia; The Noncategorical Perception of Tone Categories in Thai; Effect of Speaking Rate on Vowel Formant Movements; Effects of Transition Length on Identification and Discrimination within a Place Continuum; Perceptual Integration and Differentiation of Spectral Information across Intervocalic Stop Closure Intervals; Musical Skill and the Categorical Perception of Harmonic Mode; Phonetic and Auditory Aspects of Adaptation -- Evidence from Thai voicing contrasts; Hemispheric Specialization for Speech Perception in Kindergarten Children with Language Deficiency; Can the Intrinsic F sub 0 Differences between Vowels be Explained by Source/Tract Coupling; Relationship between Vowel and Consonant Identification when Cued by the Same Acoustic Information; and Information Conveyed by Vowels. GRA

N78-19368# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SURVEY OF WORKS CONNECTED WITH UNDERGROUND RADIOWAVE PROPAGATION
G. I. Makarov and V. A. Pavlov 27 Jul. 1977 59 p refs Transl. into ENGLISH from Probl. Difraktsii i Rasprostraneniya Volv, Rasprrostraneniye Radiovoln (USSR), no. 4, 1966 p 135-160
(AD-A048994; FTD-ID(RS)T-1243-77) Avail: NTIS HC A04/MF A01 CSCL 20/14

There are several reasons which have caused interest in investigation of the area of radiowave propagation in the earth's crust. For the first time such investigations have come to be concerned with the needs of geophysical exploration. Subsequently, the problem of the propagation of electromagnetic energy in the earth's crust drew attention in connection with the solution of certain problems of electrodynamics and the techniques of the detection of electrical signals in the earth/ground. Finally, one of the reasons is the need for the selection of the routes of radio communication, reliably shielded from cinterference (propagation of the electromagnetic energy through the deep weakly conductive layers, covered with the high-conductivity rock/species). GRA

N78-19369# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
FORMAL SPECIFICATIONS FOR PACKET COMMUNICATION SYSTEMS Ph.D. Thesis
David J. Ellis Nov. 1977 142 p refs
(Contract N00014-75-C-0661; Grant NSF DCR-75-04060)
(AD-A048980; MIT-LCS-TR-189) Avail: NTIS HC A07/MF A01 CSCL 17/2

One of the most difficult tasks facing computer scientists is that of designing systems and making sure that they perform their intended functions correctly. As computer systems have grown in size and complexity, the problems of system design and verification have become increasingly acute. Formal specifications, which are precise descriptions of a system's function, provide a basis for understanding system operation as well as for proving correctness. Although there has been much work in formal specification and verification of computer programs, relatively little research has been done on system specification. A particular class of asynchronous systems, known as packet communication systems, has been chosen as the subject of this study. Packet communication systems are composed of independently operating units that interact only by transmitting packets of information. These systems possess a number of desirable structuring properties that make them suitable for formal analysis. We have developed a model for formally describing the behavior of packet systems and for proving correctness. The model is based on the fact that packet systems may be viewed both externally, in terms of their interaction with the outside world, and internally, in terms of their structural composition from smaller units. GRA

N78-19370# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SYSTEM DESIGN STUDY FOR INFRARED AIRBORNE RADAR (IRAR)
Richard J. Becherer 18 Oct. 1977 73 p refs
(Contract F19628-78-C-0002)
(AD-A048979; TN-1977-29; ESD-TR-77-271) Avail: NTIS HC A04/MF A01 CSCL 17/5

This technical note describes the design of a tactical near-all-weather infrared airborne radar (IRAR). The requirements for this radar include both (1) wide field MTI search for target detection against a cluttered terrain background and (2) narrow field high angular resolution imagery for target recognition and identification. The principal new technology issues identified and techniques proposed include a heterodyne detection antenna/receiver in an array configuration, compact Maksutov-Cassegrain telescope optics design, MTI pulse integration signal processing, and real time image processing for speckle and glint reduction. Expected weather penetration capability for this radar is assessed with the aid of a recent analysis of real weather data from a number of locations in Central Europe. Author (GRA)

N78-19371# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
SPEECH UNDERSTANDING SYSTEMS. SUMMARY OF RESULTS OF THE FIVE-YEAR RESEARCH EFFORT AT CARNEGIE-MELLON UNIVERSITY Interim Report
Aug. 1977 182 p refs
(Contract F44620-73-C-0074)
(AD-A049288; AFOSR-78-0002TR) Avail: NTIS HC A09/MF A01 CSCL 17/2

This report is an augmented version of a report originally issued in September 1976, during the demonstration at the end of the five-year speech effort. The first section reports on the various speech understanding systems developed at CMU during the five year period and highlights their individual contributions. After a brief description of several techniques and knowledge sources that contributed to the success of the final systems, detailed performance results of the Harpy and Hearsay-II systems are provided. Results include the performance of the systems not only for the 1000 word task but for several simpler tasks. Also included are reprints of papers presented at various conferences since September 1976 and a list of publications of the CMU speech group. GRA

N78-19372# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
WORD HYPOTHESIZATION FOR LARGE-VOCABULARY SPEECH UNDERSTANDING SYSTEMS Interim Report
A. Richard Smith 20 Oct. 1977 128 p refs
(Contract F44620-73-C-0074)
(AD-A049287; AFOSR-78-0005TR) Avail: NTIS HC A07/MF A01 CSCL 17/2

This thesis describes research directed toward the development of a general English speech understanding system. In particular, the thesis presents the design and performance of a bottom-up word hypothesizer (Noah) capable of handling very large vocabularies. The design of Noah is based on a hierarchy-tree structure. Speech is represented at four levels of a hierarchy. A tree maps the representation of speech at one level to the representation of speech at the next higher level by a tree. The author concludes that bottom-up word hypothesization is not greatly effected by the size of the vocabulary. He was pleasantly surprised that the effect of vocabulary size on performance and on computation costs would be approximately according to the logarithmic of the vocabulary size. This result suggests that, with improvements in the word hypothesizer and the segmenter-labeler, speech understanding systems for general English can obtain a great amount of constraint from the acoustics alone. GRA

N78-19373# California Univ., Berkeley. Electronics Research Lab.

PROSODIC INFORMATION FOR SPEECH UNDERSTANDING SYSTEMS Final Report, 1 Feb. 1975 - 30 Sep. 1977

Michael H. O'Malley 30 Sep. 1977 9 p refs

(Grants DAHC04-75-G-0088; DAAG29-76-G-0250)

(AD-A049298) Avail: NTIS HC A02/MF A01 CSCL 17/2

The goal of this project was to use prosodic information to aid speech recognition systems. Naturalistic speech data was collected and used to test and develop hypotheses about the relationship of prosodic information to the syntactic and semantic structure of English sentences. Members of the project interacted closely with other members of the ARPA SUR project. A series of SUR notes describing acoustic features of prosodies, phonological rules, stress rules, etc. were produced. GRA

N78-19374# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.

NONLINEAR PHENOMENA IN ELECTROMAGNETIC THEORY AND ACOUSTICS Final Report, 1 Jun. 1974 - 30 Sep. 1977

Joseph B. Keller and Frank C. Hoppensteadt Jan. 1978 28 p refs

(Grant DAAG29-74-G-0219)

(AD-A049295; ARO-12387.4-M) Avail: NTIS HC A03/MF A01 CSCL 20/14

The research projects supported by these grants include investigations into problems of nonlinear wave propagation, nonlinear electrical circuits, propagation in wave guides, thermal convection and continuum mechanics. The success of these projects rested on our unified and coherent development and applications of multi-scale perturbation methods to study the complicated nonlinear systems which describe these physical phenomena. The research projects are described in forty-seven research papers and books. These are summarized in this report by area of application. Author (GRA)

N78-19375# Illinois Univ., Urbana-Champaign. Dept. of Electrical Engineering.

RESEARCH ON DETECTION OF PULSED RADIATION AT 10.6 MICRONS Final Report

O. L. Gaddy Dec. 1977 6 p refs

(Grant DAHC04-75-G-0123)

(AD-A049218; UILU-ENG-77-2271; ARO-13213.1-A-EL) Avail: NTIS HC A02/MF A01 CSCL 17/5

The results of research on fast response time infrared detectors are described. This research resulted in the development of thin film bolometer detectors capable of operation at room temperature with nanosecond response time. Author (GRA)

N78-19376# Los Alamos Scientific Lab., N. Mex.

TRANSIENT RADIATION EFFECTS IN LOW LOSS OPTICAL WAVEGUIDES

J. E. Golob, P. B. Lyons, and L. D. Looney 1977 12 p refs Presented at IEEE Conf. on Nucl. and Space Radiation Effects, Williamsburg, Virginia, 12 Jul. 1977

(Contract W-7405-eng-36)

(LA-UR-77-1564; Conf-770714-5) Avail: NTIS HC A02/MF A01

Radiation-induced effects in low-loss optical waveguides were studied to determine parameters affecting the use of these materials in plasma diagnostic instrumentation operating in severe radiation environments. Radiation-induced luminescence of fibers was shown to result from the Cherenkov process within the fibers. Both spectral data and angular dependence of luminescence were used to verify the Cherenkov effect. Absolute magnitude of luminescence data were obtained. Radiation-induced absorption was measured immediately following a 40-ns radiation pulse at wavelengths of 600 nm and 800 nm. Saturation effects in absorption were observed as well as changes in fiber recovery vs. time as a function of radiation dose. Step and graded index profile fibers were shown to exhibit comparable absorption. Fibers tested included plastic-clad silica fibers, graded and step index germanium-doped and boron-doped fibers. ERA

N78-19377# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

A UNIFIED FRAMEWORK FOR THE REALIZATION PROBLEM IN LINEAR DIGITAL FILTERING

David S. K. Chan Nov. 1977 6 p refs Presented at the 1977 Intern. Conf. on Acoustics, Speech and Signal Processing

(Contract DAAB07-76-C-1400)

(AD-A048459) Avail: NTIS HC A02/MF A01 CSCL 09/4

In a new approach to characterizing the implementation of linear digital filters all possible realizations for any filter are treated in the same framework, based on the representation of an input/output specification for a linear filter by a unique, possibly infinite transmission matrix, which can be extended to include arrays of higher than two dimensions or of arbitrary dimensions. A set of notations and operation rules for these arrays and matrices is presented, and all possible implementations of a filter are characterized as factorizations of its transmission array. GRA

N78-19378# Joint Publications Research Service, Arlington, Va.

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: BIOMEDICAL AND BEHAVIORAL SCIENCES, NO. 22

3 Mar. 1978 66 p refs Transl. into ENGLISH from Russian journals

(JPRS-70722) Avail: NTIS HC A04/MF A01

The future of Soviet genetic engineering is discussed as well as progress in industrial microbiology and toxicology, and in veterinary pharmacology and the treatment of leptospirosis in hogs. The design and results of an experiment for studying the reaction of microorganisms to magnetism are reported. For individual title, see N78-19379.

N78-19379# Joint Publications Research Service, Arlington, Va.

EFFECT OF ELECTROMAGNETIC WAVES FROM OUTER SPACE ON EARTH

V. Zharov *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 22 (JPRS-70722) 3 Mar. 1978 p 36-37 Transl. into ENGLISH from Sov. Latviya (USSR), 27 Jan. 1978 p 2 (For availability see N78-19378 10-32)

Avail: NTIS HC A04/MF A01

The effects of a magnetic field on microorganisms were investigated by the simulation and induction of a magnetic storm into growth chambers where staphlococci and spore forming bacteria were maintained at 37 C. The relationship between low frequency oscillations and the rapidity of bacterial replication was established. Such oscillations slow bacterial replication sharply. The ability of bacteria to elicit infection in animals, to react with antibiotics, and to excrete toxins is also altered. Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N78-19380 Cornell Univ., Ithaca, N. Y.

FABRICATION AND TESTING OF A MILLIMETER WAVE SURFACE SUPERLATTICE DEVICE Ph.D. Thesis

Shri Nath Gupta 1977 133 p

Avail: Univ. Microfilms Order No. 77-29367

The fabrication and testing of a surface superlattice device was carried out at V-band (66 GHz). InSb was chosen as the substrate for the superlattice fabrication since it has a large electron mean free path at 77 K. Electron beam lithography was used to make a grating on the surface of the InSb sample. The gain for an electromagnetic wave propagating on the surface of the superlattice structure was calculated. Unlike the usual surface waves, propagating surface wave on the superlattice grows with depth inside the substrate. Therefore, two methods were investigated to solve this problem: (a) implant a high resistivity layer under the superlattice structure, and (b) etch down the InSb substrate to the thickness of the superlattice. It

was shown that the sample thickness has to be equal to the thickness of the superlattice before any gain can be measured. Dissert. Abstr.

N78-19381 California Univ., Berkeley.
COMPUTER SIMULATION OF MONOLITHIC CIRCUIT PERFORMANCE IN THE PRESENCE OF ELECTRO-THERMAL INTERACTIONS Ph.D. Thesis
Kiyoshi Fukahori 1977 332 p
Avail: Univ. Microfilms Order No. 77-31360

An efficient and effective lumped modeling of the die-package structure was developed which accurately represented the thermal behavior of a wide variety of commonly used integrated circuit die-package combinations. The mathematical formulation of the coupled electrothermal system was carried out and two algorithms useful for the solution of the system were developed. The advantages and disadvantages of the two algorithms were investigated under both dc and transient conditions. A computer program was developed and used to predict the performance of a group of monolithic operational amplifiers, voltage regulators and temperature stabilized substrate systems. Dissert. Abstr.

N78-19382 Duke Univ., Durham, N. C.
A THEORY OF CONTROL FOR A CLASS OF ELECTRONIC POWER PROCESSING SYSTEMS: ENERGY-STORAGE dc-TO-dc CONVERTERS Ph.D. Thesis
William Wesley Burns, III 1977 257 p
Avail: Univ. Microfilms Order No. 7731660

An analytically derived approach to the control of energy storage dc-to-dc converters is presented which enables improved system performance and an extensive understanding of the manner in which this improved performance is accomplished. A graphical representation of the behavior of dc-to-dc converter systems yields considerable qualitative insight into the cause and effect relationships which exist between various commonly used converter control functions and the system performance which results from them such as the influence of parasitic losses in the converted power stage on the shape and location of a switching boundary. Simplification of the mathematical representation of the switching boundary are presented. Digital computer simulation data and oscillograms from an experimental converter system are presented to illustrate and verify the theoretical discussions and subsequent control law presented. Dissert. Abstr.

N78-19383 California Univ., Berkeley.
JOSEPHSON DEVICES FOR HIGH-SPEED DIGITAL CIRCUITS Ph.D. Thesis
Hugo Wai-Kung Chan 1977 210 p
Avail: Univ. Microfilms Order No. 7731313

Nonlatching logic circuits and self-resetting logic circuits that can be designed using Josephson junctions as the switching elements are described. the circuits require no pulsing of the current supply line for resetting, and can be switched between their two logic states with subnanosecond delay time. The switching behavior was simulated numerically. The choice of parameters and junction types was analyzed, and the distinctive features which make these circuits attractive are discussed. Operation of the nonlatching, self resetting and latching logic circuits were demonstrated experimentally using circuits which employ semiconductor barrier (Pb-Te-Pb) Josephson junctions as input gates. Dissert. Abstr.

N78-19384 California Univ., Berkeley.
MODEL HIGH-CURRENT EFFECTS IN BIPOLAR TRANSISTORS FOR USE IN COMPUTER AIDED DISTORTION ANALYSIS Ph.D. Thesis
Donald Georg Duff 1977 304 p
Avail: Univ. Microfilms Order No. 7731249

Present bipolar transistor models limit the accurate calculation of distortion to low collector current values. A model of a bipolar transistor was developed, simple enough to be used in a circuit analysis program for the simulation of an entire circuit, but accurate enough to allow distortion predictions for high collector currents. In addition, the model is physically oriented to allow prediction of circuit performance for variations in transistor structure. A description of previous bipolar transistor models and their limitations is given. A model was developed including base widening, dc and ac emitter crowding and lateral collector current spreading. Base widening was modeled for the general case of electric field dependent mobility. Classical emitter crowding theory was modified to include the effect of increased base charge when base widening occurs. Dissert. Abstr.

N78-19385 California Univ., Los Angeles.
HARMONIC INTERACTION IN TRAPATT DIODE OSCILLATORS Ph.D. Thesis
David Stuart Matthews 1977 270 p
Avail: Univ. Microfilms Order No. 77-30941

The nonlinear interaction of the various harmonic components of voltage and current across and through the TRAPATT diode oscillator was analyzed experimentally and theoretically. The measurement of the instantaneous current and voltage waveforms was performed to establish the harmonic characteristics of two different oscillators, a lumped element circuit, and a coaxial transmission-line circuit. The theoretical analysis was developed from the device physics and describes the operation of the oscillators within the framework of the harmonic interaction representation. Dissert. Abstr.

N78-19386 Northwestern Univ., Evanston, Ill.
TRANSIENT BEHAVIOR OF PULSE-EXCITED LOGIC GATE SYSTEMS CONTAINING TRANSMISSION LINE INTERCONNECTIONS Ph.D. Thesis
L. Craig Edgar Miller 1977 175 p
Avail: Univ. Microfilms Order No. 77-32333

The effects that delay and reflection phenomena have on the transient behavior of digital systems in which logic gates are interconnected by transmission lines and are operated at high switching speeds were analyzed by determining the transient response of a system to transition edge excitation in which the gates are represented as line terminations and the interconnections are represented as distortionless transmission lines. Saturating TTL was chosen because TTL transistors may operate in the four modes (active, reverse active, saturation, and cutoff) while transistors in other logic types may operate in as few as two of these modes. The parameter-value refinement procedure and the modeling approach developed apply, with slight modification, to other logic types such as modified TTL, Schottky-clamped TTL, MTL and ECL. Dissert. Abstr.

N78-19387 Duke Univ., Durham, N. C.
AIR-GAPPED STRUCTURES AS MAGNETIC ELEMENTS FOR USE IN POWER PROCESSING SYSTEMS Ph.D. Thesis
Anil Kumar Ohri 1977 190 p
Avail: Univ. Microfilms Order No. 77-31684

Methodical approaches to the design of inductors for use in LC filters and dc to dc converters using air gapped magnetic structures are presented. Methods for the analysis and design of full wave rectifier LC filter circuits operating with the inductor current in both the continuous conduction and the discontinuous conduction modes are presented. A family of design curves is obtained relating filter parameter values of inductance, capacitance, and load resistance to the performance factors of percentage output ripple voltage, average output voltage level, rms and peak transformer-winding currents, and input power factor. Three procedures for designing filter inductors using airgapped cores are presented. Dissert. Abstr.

N78-19388 Purdue Univ., Lafayette, Ind.
HIGH-CURRENT INJECTION MODELING OF SEMICONDUCTOR DEVICES Ph.D. Thesis
Laila Ragay Razouk 1977 234 p
Avail: Univ. Microfilms Order No. 7730125

Numerical simulations and experimental measurements were carried out to study the transient behavior of the R(+)-N(-)-N(+) structure under different levels of injection in both the reverse and the forward pulsed directions. A major part of this research was devoted to the explanation of the anomalous voltage that appears across the diode terminals when pulsed in the forward direction with current densities in the range of 1000 to 1,000,000 amp/sq cm. Dissert. Abstr.

N78-19389 Purdue Univ., Lafayette, Ind.
THE INTERNAL DYNAMICS AND SMALL SIGNAL ANALYSIS OF BARITT DIODES Ph.D. Thesis

Reda Rashad Razouk 1977 172 p
Avail: Univ. Microfilms Order No. 77-30126

A Baritt diode simulation, small signal numerical calculations, and experimental measurements have been carried out to study the internal dynamics and small signal properties of the Baritt diode. Computer simulation for the transient solution of Baritt diodes is presented. The steady state solutions obtained from the simulation are used to carry out a small signal analysis of the Baritt structure. The transient solution and small signal analysis are carried out for four different devices. The dependence of both the transient solution and small signal analysis on the drift velocity vs electric field curve was investigated. The effect of low lifetime on the steady state and the small signal negative resistance is also investigated. Dissert. Abstr.

N78-19390 Syracuse Univ., N. Y.
FIELD DISTRIBUTION INSIDE A BOX WITH APERTURE Ph.D. Thesis
Chang-Yu Wu 1977 159 p
Avail: Univ. Microfilms Order No. 7730778

An analytical numerical method is presented for the calculation of the electromagnetic field distribution inside a rectangular, thin, hollow, conducting box with a rectangular slot on its surface. The method of moments is used to obtain numerical data. The problem is three-dimensional with no rotational symmetry. The governing integral equation is first separated into coupled scalar equations. The surface currents on the box are then obtained by an inversion of a generalized impedance matrix. Once the current distribution is known, the electromagnetic field in space can be computed by conventional methods. The accuracy of the numerical results is limited by the size of the matrices involved. To alleviate this problem, an assignment method for making the generalized impedance matrix symmetrical is developed.
Dissert. Abstr.

N78-19391*# National Aeronautics and Space Administration, Washington, D. C.
THE RECALCULATION OF THE ORIGINAL PULSE PRODUCED BY A PARTIAL DISCHARGE
Florin Tanasescu Mar. 1978 19 p refs Transl. into ENGLISH from Archiv fuer Technisches Messen und Messtechnigche (Romania), no. 429, Oct. 1971 p 197-202 Transl. by Kanner (Leo) Associates, Redwood City, Calif. and Design for the Elec. Eng. Ind., Bucharest, Romania
(Contract NASw-2790)
(NASA-TM-75253) Avail: NTIS HC A02/MF A01 CSCL 09C

The loads on a dielectric or an insulation arrangement cannot be precisely rated without properly assessing the manner in which a pulse produced by a partial discharge is transmitted from the point of the event to the point where it is recorded. A number of analytical and graphic methods are presented, and computer simulations are used for specific cases of a few measurement circuits. It turns out to be possible to determine the effect of each circuit element and thus make some valid corrections. Author

N78-19392*# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
NIOBIUM-GERMANIUM SUPERCONDUCTING TAPES FOR HIGH-FIELD MAGNET APPLICATIONS Final Report, 19 Apr. 1976 - 19 Nov. 1977
A. I. Braginski, G. W. Roland, M. R. Daniel, and J. A. Woolam Nov. 1977 116 p refs
(Contract NAS3-20233)
(NASA-CR-135364; Rept-77-9F1-HYSUC-R9) Avail: NTIS HC A06/MF A01 CSCL 09C

A process of fabricating superconducting Nb3Ge tapes by chemical vapor deposition (CVD) has been developed and tapes up to 10 meters long fabricated. The typical properties achieved were: critical temperature T sub c = 20 K, upper critical field H sub c2 = 29 tesla at 4.2 K, and J sub c = 3 to 4 x 10 to the 8th power A m(-2) at 4.2 K, 18 tesla. The relative depression of T sub c and H sub c2 compared with the best thin film samples sputtered on sapphire was due to the presence of Nb5Ge3 second-phase particles used as flux pinning centers and to strains induced by thermal mixmatch with Hastelloy B tape substrates. A peculiar field dependence of flux pinning force that was observed in both CVD and sputtered Nb3Ge indicated a premature pin-breaking mechanism or a phase inhomogeneity. Directions of further optimization work were defined. Author

N78-19393*# Hughes Aircraft Co., Culver City, Calif. Aerospace Groups.
PREPARATION OF CALIBRATED TEST PACKAGES FOR PARTICLE IMPACT NOISE DETECTION Final Report, Jul. - Dec. 1977
Dec. 1977 35 p refs
(Contract NAS8-30876)
(NASA-CR-150583; HAC-Ref-D1927) Avail: NTIS HC A03/MF A01 CSCL 09C

A standard calibration method for any particle impact noise detection (PIND) test system used to detect loose particles responsible for failures in hybrid circuits was developed along with a procedure for preparing PIND standard test devices. Hybrid packages were seeded with a single gold ball, hermetically sealed, leak tested, and PIND tested. Conclusions are presented. J.M.S.

N78-19394*# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
A dc AMPLIFIER FOR NUCLEAR PARTICLE MEASUREMENT Final Report, Dec. 1975 - Nov. 1977
A. B. MacNee and N. A. Masnari Jan. 1978 107 p
(Contract NAS5-22875)
(NASA-CR-156705; Rept-014393-F) Avail: NTIS HC A06/MF A01 CSCL 09A

A monolithic preamplifier-postamplifier combination has been developed for use with solid state particle detectors. The direct coupled amplifiers employ interdigitated n-channel JFET's, diodes, and diffused resistors. The circuits developed demonstrate the feasibility of matching the performance of existing discrete component designs. The fabrication procedures for the monolithic amplifier fabrication are presented and the results of measurements on a limited number of sample amplifiers are given.
Author

N78-19395*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
RELIABILITY EVALUATION OF HERMETIC DUAL IN-LINE FLAT MICROCIRCUIT PACKAGES Final Technical Report, Oct. 1976 - Dec. 1977
G. M. Johnson and L. K. Conaway Dec. 1977 195 p refs
(Contract NAS8-31446)
(NASA-CR-150597) Avail: NTIS HC A09/MF A01 CSCL 09C

The relative strengths and weaknesses of 35 commonly used hermetic flat and dual in-line packages were determined and used to rank each of the packages according to a numerical weighting scheme for package attributes. The list of attributes included desirable features in five major areas: lead and lead seal, body construction, body materials, lid and lid seal, and marking. The metal flat pack and multilayer integral ceramic flat pack and DIP received the highest rankings, and the soft glass Cerdip and Cerpak types received the lowest rankings. Loss of package hermeticity due to lead and lid seal problems was found to be the predominant failure mode from the literature/data search. However, environmental test results showed that lead and lid seal failures due to thermal stressing was only a problem with the hard glass (Ceramic) body DIP utilizing a metal lid and/or bottom. Insufficient failure data were generated for the other package types tested to correlate test results with the package ranking. Author

N78-19396*# National Aeronautics and Space Administration, Washington, D. C.
CALCULATION PRINCIPLES FOR A SYNCHRONOUS ELECTROMAGNETIC CLUTCH
M. A. Panasenkov Mar. 1978 13 p ref Transl. into ENGLISH from Elektrotechnika (USSR), no. 1, Jan. 1967 p 39-41 Transl. by SCITRAN, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75234) Avail: NTIS HC A02/MF A01 CSCL 09C

A detailed explanation of the calculation principles, for a synchronous salient-pole electromagnetic clutch with lumped excitation windings is supplied by direct current. Practical recommendations are given. Author

N78-19397*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
UP-DATE OF TRAVELING WAVE TUBE IMPROVEMENTS
Erik Buck 1978 15 p ref Presented at Electronic Warfare Symp., Warner Robins AFB, Ga., 20-24 Mar. 1978
(NASA-TM-78852; E-9572) Avail: NTIS HC A02/MF A01 CSCL 09C

A brief survey is presented of areas of progress on traveling wave tube designs. Data demonstrates the effect of multistage depressed collectors, the design of which is made possible by powerful NASA computer programs. Other topics include beam refocusing, RF circuit losses, and cathode testing. Author

N78-19398# Westinghouse Research Labs., Pittsburgh, Pa.
INFLUENCE OF INTERCONNECTION AND BIASING CONFIGURATIONS ON THE OPERATION OF JOSEPHSON JUNCTIONS AS RADIATION SOURCES Final Report, 1 Mar. 1976 - 30 Jul. 1977
Michael R. Daniel, Martin Ashkin, and Michael A. Janocko Sep. 1977 56 p refs
(Contract N00014-76-C-0609)
(AD-A048592; Rept-77-9F1-SUCON-R1) Avail: NTIS HC A04/MF A01 CSCL 09/5

This final report of ONR Contract No. N00014-76-C-0609 describes some initial experimental work and then calculations on an analogue computer of properties of Josephson junctions used as a frequency agile source. The results of the calculations show that a junction may be used as a nearly ideal (zero impedance) dc voltage source with which to bias a second junction. The junctions must be isolated rf-wise from each other and the inductance level between them must not exceed about 10 to the minus 8 power H for operation at liquid helium temperatures. The second junction will then oscillate at a frequency determined by this bias voltage. Additionally the same junction bias source was shown to be capable of biasing a series array of junctions. The series array was shown to oscillate phase coherently at a frequency determined by the divided bias voltage across each junction. Author (GRA)

N78-19399# Rockwell International Corp., Anaheim, Calif. Electronics Research Center.
GPO/GAAS(0.5)P(0.5) MOS CAPACITORS Final Technical Report, 1 Jun. - 1 Sep. 1977
Gordon J. Kuhlmann, D. Howard Phillips, and Ranjeet K. Pancholy 15 Sep. 1977 72 p refs
(Contract DAAK70-77-C-0122)
(AD-A048632; C77-928/501) Avail: NTIS HC A05/MF A01 CSCL 09/1

This report presents the results of a program to investigate the surface passivation properties of a dielectric thermally grown on GaAs(0.5)p(0.5). Oxide films were grown at 700 C in dry oxygen. Ion microprobe analysis of the oxide composition indicates that the bulk of the oxide is arsenic deficient and that there is an arsenic-rich insulator-semiconductor interface region. Current-voltage characteristics showed a Frenkel-Poole type of conduction with a transient behavior due to electron trapping. Dielectric strength averaged 1.75 x 10 to the 6th power V/cm for unannealed films. Depletion-type C-V characteristics were observed, and are a result of the low minority carrier generation rate in the wide bandgap GaAs(0.5)P(0.5). Hysteresis in the C-V characteristics is attributed to electron trapping in states which are not in equilibrium with the bias sweep voltage. The static dielectric constant of the oxide was determined to be 6.3 from the C-V characteristics. Interface trap density in the upper portion of the bandgap was determined to be about 8 x 10 to the 11th power per sq cm per eV using the capacitance differentiation method. A significant illumination effect on this trapping behavior was observed due to emptying of electron traps. Interface analyses based on conductance-voltage data were inconclusive because existing analytical models are apparently not adequate for III-V compound MOS interfaces. Author (GRA)

N78-19400# Cober Electronics, Inc., Stamford, Conn.
HIGH VOLTAGE NANOSECOND PULSE GENERATOR Triennual Report, 1 May - 30 Aug. 1977
Joseph Bajda and Stephen Geiger Nov. 1977 29 p
(Contract DAAB07-77-C-2641)
(AD-A048616; ECOM-77-2641-2) Avail: NTIS HC A03/MF A01 CSCL 09/5

This Second Triannual Report describes work performed during the period 1 May 77 to 30 Aug 77 to develop three high voltage nanosecond pulse generators. The objective of the development is a set of pulse generators of small volume, low weight, and high efficiency. Testing of the power supply and modulator for Task A Pulse Generator, operating either single pulse or 15 Hz at a pulse width of 125 ns, pulse voltage of 30 kV, and pulse current of 1200 amps, has been initiated. The design of an SCR-magnetic modulator for Task B Pulse Generator, providing a 5 kV, 4 A, 100 ns pulse to the load, has been completed. Switches to meet the ultra high speed requirements for Task C Pulse Generator were evaluated in test circuits. Author (GRA)

N78-19401# Army Electronics Command, Fort Monmouth, N. J.
US ARMY PANAMA FIELD TEST OF PLASTIC ENCAPSULATED DEVICES
Edward B. Hakim Jul. 1977 16 p
(AD-A048413) Avail: NTIS HC A02/MF A01 CSCL 09/5

Field testing of hermetic and plastic encapsulated semiconductors has shown that ceramic dual-in-line packages (DIP) are superior than most plastic packages. Hermetic flat packs, however, are poorer than most plastic packages and a device fabricated with a trimetal interconnection metallization and an epoxy novolac encapsulant can be as good as ceramic DIPs. Silicone encapsulated devices are usually the poorest performers. Devices tested in the storage condition have, in some cases, poorer results than their equivalent, which have been biased. This can be attributed to reduction of the relative humidity at the chip surface due to a higher temperature produced by the power dissipation of the device. In general, in this field test program, plastic devices have not performed as poorly as had been expected. Newer devices, which include CMOS circuits and integrated circuits fabricated with various tape-chip carrier processes, are beginning evaluation. Results from tests on these units will be a good yard stick in assessing the reliability of semiconductors in the future. GRA

N78-19402# Ball Bros. Research Corp., Boulder, Colo. Aerospace Div.
MICROSTRIP ANTENNAS FOR MILLIMETER WAVES Final Report, Apr. 1976 - 31 Mar. 1977
Michael A. Weiss Ft. Monmouth, N. J. ECOM Oct. 1977 66 p
(Contract DAAB07-76-C-0110)
(AD-A048453; F77-07; ECOM-76-0110-F) Avail: NTIS HC A04/MF A01 CSCL 09/5

This study was conducted to demonstrate the feasibility of low cost, conformal, printed circuit board arrays at millimeter frequencies. Development was concentrated in three basic areas: waveguide to microstrip transitions, a 4x4 element array at 35 GHz, and a 4x4 array at 60 GHz. The program was successful in each area of investigation. Author (GRA)

N78-19403# Brown Univ., Providence, R. I. Dept. of Chemistry.
PREPARATION AND PHOTOELECTROLYTIC BEHAVIOR OF THE SYSTEMS WO(3-X) AND WO(3-X)Fx Technical Report, 1 Jun. - 31 Oct. 1977
C. E. Derrington, W. S. Godek, C. A. Castro, and A. Wold 10 Nov. 1977 24 p refs
(Contract N00014-77-C-0387)
(AD-A048463; TR-2) Avail: NTIS MF A01 CSCL 07/2

A convenient method of preparing compounds in the system WO(3-x)Fx is described and the photoelectrolytic behavior of WO(3-x) and WO(3-x)Fx anodes has been investigated. It was found that the substitution of small amounts of fluorine for oxygen in WO3 does not affect adversely its photoelectrolytic behavior. Moreover, substituted fluorine increases the stability of electrodes of WO 3 when used for the photoelectrolysis of water. Author (GRA)

N78-19404# Rockwell International Corp., Anaheim, Calif. Autonetics Group.
A RADIATION-HARD CMOS/SOS ALU
R. A. Kjar, M. Martinez, and A. E. Waskiewicz 5 Oct. 1977

6 p refs Presented at the 23rd Conf. on Magnetism and Magnetic Mater., Minneapolis, 8-11 Nov. 1977
(Contract F04704-75-C-0007)
(AD-A048738; X77-972/501) Avail: NTIS HC A02/MF A01 CSCL 09/5

A radiation-hard CMOS/SOS technology has been used to fabricate a complex LSI circuit containing over 2200 transistors. The circuit is an eight bit wide arithmetic and logic unit (ALU) slice. This paper describes the results of electrical, temperature, and radiation tests on the ALU circuit. An instruction cycle-time of less than 240 ns was achieved for nominal operation at -11V and 25 C. This time increases to 300 ns at 125 C. After irradiation to 1 mega rad. (Si) under bias, operation was degraded only slightly. The 25 C and 125 C postradiation cycle times were within 320 and 360 ns, respectively. Radiation tolerance from part to part and lot to lot was excellent, thus demonstrating the applicability of radiation hard CMOS/SOS to LSI circuitry.
Author (GRA)

N78-19405# Rockwell International Corp., Anaheim, Calif. Autonetics Group.
AN ELECTRICAL SURGE ARRESTOR (ESA) MODEL FOR ELECTROMAGNETIC PULSE ANALYSIS
C. T. Kleiner, E. D. Johnson, L. R. McMurray, and F. T. Suzuki 27 Sep. 1977 8 p refs Presented at the IEEE Trans. on Nuclear Sci., Dec. 1977
(Contract F04704-76-C-0008)
(AD-A048737; X77-958/501) Avail: NTIS HC A02/MF A01 CSCL 09/5

Electrical Surge Arrestors (ESA's) have been used extensively for lightning and EMP protection. These components are characterized by (a) presenting an open circuit (high impedance) below the gap breakdown potential, (b) becoming a virtual short-circuit above the gap breakdown and (c) displaying a significantly higher level of apparent gap breakdown for very fast input voltage rise-times (dv/dt). This paper describes a mathematical model for a spark gap surge arrestor which has been used successfully to characterize ESA response to stimulus. GRA

N78-19406# Radio Corp. of America, Lancaster, Pa. SSD-Electro-Optics and Devices.
MANUFACTURING METHODS AND TECHNOLOGY (MM AND T) MEASURE FOR FABRICATION OF SILICON TRANSCALENT THYRISTOR Quarterly Progress Report, 1 Jul. - 30 Sep. 1977
B. B. Adams, S. W. Kessler, R. E. Reed, and D. R. Trout Oct. 1977 68 p
(Contract DAAB07-76-C-8120)
(AD-A048845; QPR-4) Avail: NTIS HC A04/MF A01 CSCL 09/1

This fourth Quarterly Report describes the progress on the MM and TE program for transcalent (Heat-pipe cooled) thyristors. Production engineering measures for the device and the pertinent state-of-the-art on the sample devices are included. Final test results on the engineering sample devices shipped and initial test results on the first confirmatory samples are listed. Author (GRA)

N78-19407# Rockwell International Corp., Anaheim, Calif. Electronic Devices Div.
AN ELECTRICAL SURGE ARRESTOR (ESA) MODEL FOR COMPUTER-AIDED DESIGN AND EVALUATION
C. T. Kleiner 2 Nov. 1977 9 p refs Presented at the 11th Ann. Asilomar Conf. on Circuits, Systems and Computers
(AD-A048803; X77-1102/501) Avail: NTIS HC A02/MF A01 CSCL 09/5

Electrical Surge Arrestors (ESA's) are widely used to protect susceptible electrical and electronic components sub-systems and systems from the potentially damaging effects of lightning, static discharge, Electromagnetic interference and the Electromagnetic pulse arising from potential nuclear weapon detonations. ESA's are very nonlinear devices when operating near or above the dc break-down potential. The ESA model to be described accounts for a significant number of nonlinear effects including (1) streamer formation, (2) plasma conductivity, (3) glow region, (4) arc extinguishing, (5) high frequency oscillations, (6) Thermionic effects, and (7) heating and heat dissipation to the surrounding medium. GRA

N78-19408# Rockwell International Corp., Anaheim, Calif. Electronic Devices Div.
STABILITY DIAGRAM FOR AN ADAPTIVE RECURSIVE FILTER
Loren R. McMurray 2 Nov. 1977 6 p refs Presented at the 11th Ann. Asilomar Conf. on Circuits, Systems and Computers
(AD-A048808; X77-1054/501) Avail: NTIS HC A02/MF A01 CSCL 09/5

Adaptive digital filters are being used and proposed for various applications. The adaptive recursive filter by Feintuch is an example. A stability triangle is developed analytically for this nonlinear adaptive recursive filter using a frozen-time viewpoint. There are reasons to believe that the average stability triangle is correlated to the true stability region for all modes of operation. Computer simulation of two cases of the adaptive filter in the coefficient evaluation mode shows that the stability triangle predicts the stable region with reasonable accuracy for the cases considered. Author (GRA)

N78-19409# Rockwell International Corp., Anaheim, Calif. Electronics Research Center.
EQUIVALENT GAIN FORMS FOR CTD FILTERS
Stanley A. White Nov. 1977 6 p refs
(AD-A048805; X77-1037/501) Avail: NTIS HC A02/MF A01 CSCL 09/5

There are three equivalent forms for expressing the gains of transversal analog filters which are mechanized with charge-transfer devices (CTD's). Due to charge-transfer inefficiency (CTI), eta, the equivalence of expression is not obvious. This paper presents a simple tabulation of equivalences, their uses, and their derivations. This problem and solution also extend to include the recursive case. Arbitrary discrete-time recursive transfer functions are often mechanized digitally as second-order sections. Equivalent analog realization using charge-transfer devices cannot use the same gain parameters because of the effects (again) of charge-transfer inefficiency. This paper further includes an expression for corrected gains to compensate for this charge-transfer inefficiency in the recursive structure. GRA

N78-19410# Microwave Associates, Inc., Burlington, Mass.
MM AND T PROGRAM FOR THE ESTABLISHMENT OF PRODUCTION TECHNIQUES FOR HIGH POWER BULK SEMICONDUCTOR LIMITERS Quarterly Report, 23 Dec. 1976 - 22 Mar. 1977
Yoginder Anand and Paul Bakeman Apr. 1977 72 p
(Contract DAAB07-76-C-0039)
(AD-A049129; ECOM-0039-3; QR-3) Avail: NTIS HC A04/MF A01 CSCL 09/5

X band limiters were fabricated using high resistivity silicon. Bulk limiters from several sources exhibited power handling capacity of 15 to 25 kW. Batch processes and ball processes were introduced to manufacture the bulk limiters at a low cost with good yield. Various parameters were optimized to achieve both bandwidth and RF power goals of the contract. Author

N78-19411# Microwave Associates, Inc., Burlington, Mass.
MM AND T PROGRAM FOR THE ESTABLISHMENT OF PRODUCTION TECHNIQUES AND THE PILOT PRODUCTION OF A HIGH EFFICIENCY HIGH POWER GaAs READ-TYPE IMPATT DIODE Quarterly Report, 29 Apr. - 31 Aug. 1977
Robert E. Walline and John L. Heaton Ft. Monmouth, N. J. ECOM Aug. 1977 83 p refs
(Contract DAAB07-77-C-0324)
(AD-A049128; ECOM-0324-2; QR-2) Avail: NTIS HC A05/MF A01 CSCL 09/1

An epitaxial GaAs system has been designed for growth of low-high-low GaAs for use in Read-type IMPATT diodes. This epitaxial system includes a computer control system for the operation and monitoring of the epitaxial growth process.
Author (GRA)

N78-19412# Army Electronics Command, Fort Monmouth, N. J. Electronics Technology and Devices Lab.
FINE PARTICLE LI-FERRITE FOR APS MILLIMETER-WAVE

PHASE SHIFTER

A. Tauber, R. O. Savage, Jr., T. Collins, J. Mitchell, J. R. Shappirio, and D. W. Eckart Dec. 1977 12 p refs Presented at the 23rd Ann. Conf. on Magnetism and Magnetic Mater., Minneapolis, 8-11 Nov. 1977

(AD-A049136; ECOM-4556) Avail: NTIS HC A02/MF A01 CSCL 09/5

Powders composed of spheroidal particles 0.5-0.6 micrometer average size have been synthesized by rapidly quenching melts in the system lithium carbonate-boron oxide-iron oxide. The flow characteristics of the powders are adequate to fabricate Li-ferrite ceramic bodies by arc-plasma-spraying (APS) the powders. Post annealing leads to densification and grain growth with concomitant decrease in coercive force and increase in magnetization and remanence. Inversions in X-ray diffraction line intensity disappear with APS and annealing, yielding expected cation distribution. The inadvertent introduction of zinc accounts for the observed inverse relationship between magnetic moment and Curie temperature. The synthetic powder process requires further refinement to improve powder flow characteristics.

Author (GRA)

N78-19413# Edgerton, Germeshausen and Grier, Inc., Salem, Mass. Electronic Components Div.

FORTY KILOVOLT MEGAWATT AVERAGE POWER THYRATRON (MAPS 40) Final Report, 20 May 1976 - 15 Jul. 1977

J. J. Hamilton and D. V. Turnquist Oct. 1977 59 p

(Contract DAAB07-76-C-1352)

(AD-A049130; ECOM-76-1352-F) Avail: NTIS HC A04/MF A01 CSCL 09/3

The purpose of this 12 month program is to develop a 40 kilovolt-megawatt average power thyratron. Electrical objectives are to switch 40 kiloamperes at 40 kilovolts with a pulse width of 10 microseconds and a repetition rate of 125 hertz. A thyratron design to meet these objectives was evolved. Following extensive development in the areas of electromechanical design, processing and testing, as well as special design and evaluation effort, several thyratrons were fabricated which met the objectives of the program to the extent that it was possible to evaluate them with existing facilities at ECOM. Author (GRA)

N78-19414# Honeywell, Inc., St. Petersburg, Fla. Avionics Div.

MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING FOR TAPE CHIP CARRIER Quarterly Report, 30 Sep. 1977

William R. Rodrigues DeMiranda Nov. 1977 53 p refs

(Contract DAAB07-77-C-0526)

(AD-A049179; ECOM-77-0526-1) Avail: NTIS HC A04/MF A01 CSCL 09/5

The purpose of this program is to demonstrate the concept of an automated assembly line for hybrid microcircuits, through the establishment of techniques for tape carrier mounting of semiconductor chips, burn-in and testing of these chips on tape and their placement into representative hybrid circuits. The Tape Chip Carrier (TCC) system permits mounting of semiconductor chips on reels of sprocketed film. The system is an established means of automating the interconnection of individually packaged semiconductor chip devices. It has been adapted to the fabrication of hybrid microcircuits used in the manufacture of certain commercial computers. Its overall adaptation to the hybrid microcircuit industry is expected to be greatly enhanced by this program. The automated assembly line will make use of an automatic feed mechanism at each process step, and magazines to transport substrates and partially assembled circuits between process points. Author (GRA)

N78-19415# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

ELECTRICAL EFFECTS OF SNOW AND ICE COATINGS ON REFLECTOR ANTENNAS Final Report

William A. Davis Dec. 1977 42 p refs

(AD-A048964; AFIT-TR-77-8) Avail: NTIS HC A03/MF A01 CSCL 09/5

In recent years, the effects of icing on reflector antenna systems used in precision approach radars has become an ever increasing problem of interest. This paper presents a simple technique that may be used for the analysis of the icing on such reflector systems. For simplicity, the ice is assumed to have a uniform vertical thickness over the upper side of exposed surfaces. Beginning with a uniform phase front in the beam direction for the uniced reflector, one can trace rays back to the reflector using geometrical optics to determine the angle of incidence at each point on the reflector. The phase and amplitude of the rays for the iced reflector are computed by local plane wave analysis and used to calculate the far field in the manner of physical optics. This technique gives downward beam shifts of up to 30 milliradians for some typical reflectors. This technique modifies the array aperture function. The full pattern can be obtained from the convolution of the computed pattern with the pattern of the original system. Author (GRA)

N78-19416# Naval Ocean Systems Center, San Diego, Calif.

TESSAC EM-POWER TASK TECHNOLOGY CAPABILITIES SPECIFICATIONS Final Report

J. Foutz and J. L. Henry 30 Sep. 1977 166 p refs Revised

(AD-A048957; NOSC/TD-110) Avail: NTIS HC A08/MF A01 CSCL 10/2

EM-Power is the TESSAC name for the subset of EMC, EMV, EMP, and EM-Safety related to the platform electrical power system, power conversion in electronic and other systems and signal ground. This document identifies EM-Power issues, discusses the state of EM-Power technology, identifies Navy capability in EM-Power, and discusses the adequacy of specifications and standards related to EM-Power. Author (GRA)

N78-19417# Purdue Research Foundation, Lafayette, Ind.

THE EFFECTS OF SUBSTRATE COMPOSITION ON THICK FILM CIRCUIT RELIABILITY Quarterly Report, 1 Aug. - 31 Oct. 1977

30 Nov. 1977 28 p refs

(Contract N00019-77-C-0327)

(AD-A048890; QR-3) Avail: NTIS HC A03/MF A01 CSCL 09/1

The initial stage sintering kinetics for lead borosilicate glasses were studied in order to determine the effect of substrate dissolution in the glass on the surface tension to viscosity ratio. Substrate additions up to 10 weight percent decreased the magnitude of this ratio by a factor of 10 but left its temperature dependence unchanged. Thick film resistors were fabricated with and without substrate dissolved in the resistor glass, and differences up to a factor of 100 were found in both the magnitude and temperature dependence of the sheet resistance.

Author (GRA)

N78-19418# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FREQUENCY SYNTHESIZERS

Vladimir Volarevic 21 Jul. 1977 43 p refs Transl. into ENGLISH from Vojnotehnicki Glasnik (Yugoslavia), v. 76, no. 3, May-Jun. 1976 p 318-339

(AD-A049242; FTD-ID(RS)T-0829-77) Avail: NTIS HC A03/MF A01 CSCL 09/5

Synthesizers are complex systems for generating a large number of stable frequencies. The reduction of the radio-transmitter frequency band-widths due to the ever increasing number of communication devices that cause a saturation of the available frequency bands, and the required high quality of transmission require highly stable radio frequency sources. Sources of high frequencies based on the principle of adding frequencies, ie., synthesis, enable the use of multiple channel devices with fast selection of the desired channel. Similar problems are encountered with the construction of measuring generators.

Author (GRA)

N78-19419# Naval Civil Engineering Lab., Port Hueneme, Calif.

MAINTENANCE TESTING OF NAVY UNDERGROUND HIGH VOLTAGE CABLES Final Report, Jul. 1974 - Sep. 1976

J. L. Brooks and C. B. Beck Nov. 1977 42 p refs

(YF53534006)

(AD-A049254; CEL-TN-1506) Avail: NTIS HC A03/MF A01 CSCL 13/13

Methods of testing high voltage underground cable were investigated in order to find an alternative to the dc high-potential (hi-pot) test for cable maintenance testing. The search for such

a method proved fruitless, however. The problems of using the dc hi-pot test are discussed, and a recommended procedure of testing is presented. In addition, a new method of locating cable faults is described and recommended. Author (GRA)

N78-19420# Lincoln Lab., Mass. Inst. of Tech., Lexington.
HIGH-POWER, HIGH EFFICIENCY UHF AMPLIFIER DESIGN
Mark L. Stevens 18 Nov. 1977 30 p refs
(Contract F19628-78-C-0002)
(AD-A049289; TN-1977-45; ESD-TR-77-281) Avail: NTIS HC A03/MF A01 CSCL 09/5

The load-pull technique is shown to be a powerful tool in the design of high-power high efficiency UHF amplifiers. Construction techniques are described which produce high-efficiency amplifiers in the UHF band which require no tuning after assembly. The performance of several amplifiers covering a wide range of output powers is described. Author (GRA)

N78-19421# Hughes Research Labs., Malibu, Calif.
OPTICAL-MICROWAVE INTERACTIONS IN SEMICONDUCTOR DEVICES Quarterly Report, 15 Sep. - 16 Dec. 1977
Huan-wun Yen and Michael K. Barnoski Jan. 1978 31 p refs
(Contract N00173-77-C-0156)
(AD-A049322; QR-2) Avail: NTIS HC A03/MF A01 CSCL 09/5

The design and fabrication of a GaAs FET microwave oscillator was described. The optical injection locking property of this oscillator was studied. It was also found that the frequency jitter of the oscillator output could be reduced through optical illumination. A novel scheme of microwave mixing in a GaAs FET amplifier was demonstrated, where the local oscillator signal was introduced through optical injection. A new approach of obtaining optical injection locking of oscillators was developed where a FET amplifier was connected to the oscillator to be locked and the modulated laser beam was used to illuminate the amplifier instead of the oscillator directly. The merits and disadvantages of this technique were discussed. The direct amplitude modulation speed of a single mode GaAlAs injection laser was found to be at least 6 GHz. The output power versus input current characteristics of the same laser was determined to be better than -40 dB in second harmonic distortion.
Author (GRA)

N78-19422# Stanford Research Inst., Menlo Park, Calif.
DESIGN CONSIDERATIONS FOR A MICROWAVE SCINTILLATION EXPERIMENT Final Report, 16 Sep. 1976 - 15 Mar. 1977
Edward J. Fremouw, Boyd C. Fair, Roland T. Tsunoda, Roy A. Long, and Alan A. Burns 15 Mar. 1977 66 p refs
(Contract DNA001-76-C-0389)
(AD-A049203; AD-E300030; DNA-4092F) Avail: NTIS HC A04/MF A01 CSCL 17/2

The plasmaspheric irregularities that produce radiowave scintillation at frequencies above 1 GHz near the geomagnetic equator, and the signal perturbations that they impose, are of considerable importance to DNA responsibilities. This report describes possible experimental approaches to understanding the phenomenon of microwave scintillation that could be conducted during the forth-coming period of increased solar activity. We take it to be axiomatic that the key measurement is of GHz scintillation itself, although consideration is given to corollary measurements. Because GHz scintillation is less common than VHF-UHF scintillation, and because understanding the phenomenon would be fostered greatly by observation throughout the complete evolution of GHz-scintillation events, the recording of signals transmitted for a geostationary satellite is stressed. One of the salient results of the Wideband satellite experiment has been the demonstration of the close relationship between the measured signal phase and the plasma structure that produces scintillation. For this reason, we consider it essential that the prime experiment includes measurement of phase scintillation. Several approaches to obtain the necessary coherent signals radiated from a geostationary satellite are considered; they include a dedicated launch, a dedicated satellite on a 'piggy back' launch, a payload on a multiple-experiment SAMSO satellite, and the use of a satellite already in orbit. GRA

N78-19423# Rome Air Development Center, Griffiss AFB, N.Y.
InP: AN ASSESSMENT OF UNITED STATES ACTIVITIES Interim Report
J. K. Kennedy, H. Lessoff, and D. L. Lile Nov. 1977 58 p refs
(AD-A049283; RADC-TR-77-398) Avail: NTIS HC A04/MF A01 CSCL 09/1

The activities toward developing a viable InP technology in the United States are quite recent. However, they now encompass a broad spectrum ranging from compounding through epitaxial deposition of ternary and quaternary alloys to device evaluation. Undoped semicrystalline InP has been prepared with mobilities of greater than 5400 and 90,000 sq. cm./volt sec at 300 K and 77 K respectively. Semiinsulating single crystals have been made with resistivities in excess of 10 to the 7th power ohm-cm having iron doping concentrations in the low 10 to the 16th power atoms/cc range. Liquid phase epitaxial InP films grown directly on semiinsulating substrates have yielded carrier concentrations of 1 x 10 to the 15th power and mobilities of over 70,000 at 77 K. This review will discuss questions concerning the material aspects, the band structure, the transport and chemical properties, and the devices of indium phosphide in an effort to resolve the primary question - is there a future for indium phosphide in microwave and millimeter wave devices and systems. Author (GRA)

N78-19424# Quantronix Corp., Smithtown, N.Y.
A LASER DEFECT REPAIR SYSTEM FOR SAW DEVICES Final Technical Report, 1 Apr. 1976 - 30 Mar. 1977
Martin G. Cohen Griffiss AFB, N. Y. RADC Nov. 1977 75 p
(Contract F19628-76-C-0160)
(AD-A049304; RADC-TR-77-382) Avail: NTIS HC A04/MF A01 CSCL 09/1

A laser system has been designed and built for the repair of defects in SAW devices. The system employs a precisely-focused beam from a frequency-doubled Nd:YAG laser to machine metallic material on or near the interdigital fingers of SAW devices, thereby removing 'shorted' electrodes. The study and design concentrated on the ability to machine submicro meter-sized holes by melting of the metal conductors without damaging the crystalline substrate. It was found that this was best accomplished using the 0.53 micrometer radiation of a doubled-Nd:YAG laser, expanded to provide nearly-uniform illumination of a high numerical-aperture focusing objective. Effort was also expended on optimizing the device handling, viewing and positioning system to permit accurate machining of these small areas. The results obtained demonstrated that repairs could be successfully made without apparent damage to the SAW devices. Author (GRA)

N78-19425# Varian Associates, San Carlos, Calif. Eimac Div.
MANUFACTURING METHODS AND TECHNOLOGY (MMTE) MEASURE FOR FABRICATION OF LOW VOLTAGE START SEALED BEAM ARC LAMPS Quarterly Progress Report, 1 Mar. - 30 Sep. 1977
Roy Roberts and Tim Bell 28 Oct. 1977 30 p refs
(Contract DAAB07-76-C-0034)
(AD-A049018; EIMAC-QPR-76-4; EIMAC-QPR-76-5) Avail: NTIS HC A03/MF A01 CSCL 13/1

A program is in progress to establish a production capability for the purpose of meeting estimated military needs for the X6335, a 1kW sealed beam xenon arc lamp with low voltage starting mechanism. In accordance with the requirements of the contract, the third engineering sample is still undergoing fabrication to meet specification. Improvements were made to reduce manufacturing costs and improve reliability. These included: Sapphire window assembly seal redesigned to reduce high stress levels. Self-fixturing for brazing wherever possible. Porosity problems minimized. Body diameter smaller in size to reduce lamp and fixturing costs. Method of attaching cathode improved to minimize the number of parts required and to reduce the number of braze cycles necessary to complete the assembly. Stinger mechanism redesigned to improve reliability.
Author (GRA)

N78-19426# Naval Research Lab., Washington, D. C. Target Characteristics Branch.
A PHASED ARRAY MAINTENANCE MONITORING SYSTEM, PART 1 Interim Report

J. K. Hsiao and J. P. Shelton Sep. 1977 38 p
(Contract DOT-FA-75WAI-556)
(AD-A049063; AD-E000049; NRL-MR-3613) Avail: NTIS HC A03/MF A01 CSCL 09/5

Two methods are described for detecting failures in a phased array through the use of an integral r-f maintenance monitor system. Both methods use an r-f sampling manifold located at the radiating aperture. The methods represented are not exhaustive and are intended as examples. The first method, the balanced monitoring system, requires an adjustment network for zeroing the initial reading, while the second method, Fourier transform system, requires a Fourier transformation computation. Results of computer simulation of these two methods are presented. This is the first part of this report which treats only a conventional phased array. An array using COMPACT network will be discussed in part 2 of this report. Author (GRA)

N78-19427# Union Carbide Corp., Tarrytown, N.Y.
SUPERCONDUCTING CABLE SYSTEM. VOLUME 2, APPENDIX 1A: TECHNICAL BACKGROUND, CRYOGENIC ENVELOPE AND REFRIGERATION SYSTEM Final Report
R. Meyerhoff and H. Morihara May 1977 379 p
(Contract EX-76-C-01-1420; EPRI Proj. RP-7807-2)
(EPRI-EL-402-Vol-2) Avail: NTIS HC A17/MF A01

Appendices to a final research report on a proposed superconducting cable system for ac power transmission are presented. Included are the following: Technical background of the cryogenic envelope and refrigeration system; method for calculating envelope heat leak; construction procedures and costs for the installation of superconducting cable systems; cost estimate summaries and worksheets; construction schedule-production of Nb-Cu-Invar composite conductor; and development of superconducting cable termination and its epoxy bushing. Author (ERA)

N78-19428# Sandia Labs., Albuquerque, N. Mex.
ELECTRICAL PROPERTIES OF DUPONT BIROX AND CERMALLOY THICK FILM RESISTORS II: CONDUCTION MECHANISMS
G. E. Pike and C. H. Seager May 1977 140 p refs
(Contract EY-76-C-04-0789)
(SAND-76-0558) Avail: NTIS HC A07/MF A01

An experimental study of the electrical conduction mechanisms in thick film resistors is presented. The resistors were made from one custom and three commercially formulated inks with resistivity compositions ranging from 100 to 1,000,000 OMEGA/square in decade increments. Their microstructure and composition have been examined using optical and scanning electron microscopy, electron microprobe analysis, X ray diffraction, and various chemical analyses. This portion of the study shows that the resistors are heterogeneous mixtures of metal oxide particles and a lead silicate glass. The metal oxide particles are ruthenium containing pyrochlores, and are joined to form a continuous three dimensional network of chain segments. The principal experimental work reported is an extensive study of the electrical transport properties of the resistors. ERA

N78-19429# Bendix Corp., Kansas City, Mo.
DEPOTTING ELECTRONIC ASSEMBLIES Final Report
C. J. Camp Mar. 1976 13 p refs Revised
(Contract EY-76-C-04-0613)
(BDX-613-1530-Rev) Avail: NTIS HC A02/MF A01

The MC2807 comprises four circuit board assemblies which are encapsulated in (PAPI) Pacific Automated Products Incorporated cured polyurethane foam. A solvent formulation was sought that would remove the PAPI foam with minimum damage to the circuit board and its attached components. Several formulations were developed that met this objective. ERA

N78-19430# Bendix Corp., Kansas City, Mo.
DEVELOPMENT OF AN AUTOMATED ENCAPSULATION SYSTEM Final Report
J. B. Gallaher Jul. 1977 29 p
(Contract EY-76-C-04-0613)
(BDX-613-1493-Rev) Avail: NTIS HC A03/MF A01

Early development failures in two types of high voltage electronic assemblies pointed out the inadequacies of the current encapsulation process. Voids in the mass encapsulant resulted in the destruction of the units during electrical testing in vacuum. An automated material processing system was conceived and a prototype machine was designed and fabricated implementing this concept. Environmental controls and new capabilities were incorporated to provide the complete process control necessary to assure void free encapsulation of densely packaged electronic products. Machine performance was extensively evaluated to assure that all existing material specifications and quality control provisions would be met. Material processing was simplified which in turn made the encapsulation process more economical. In most cases, a 25 percent decrease in encapsulation costs can be anticipated. ERA

N78-19431# Bendix Corp., Kansas City, Mo.
SOLID STATE CONNECTOR Final Report
R. A. Hayes Mar. 1977 19 p refs
(Contract EY-76-C-04-0613)
(BDX-613-1479) Avail: NTIS HC A02/MF A01

A soft contact tester to product interface capability was evaluated. A solid state connector material capable of producing scratchless distinct isolated electrical contacts was examined. Material characteristics were examined and applications are presented. Implementation suggestions and considerations are listed. ERA

N78-19432# Brookhaven National Lab., Upton, N. Y.
STABILITY OF HIGH FIELD SUPERCONDUCTING DIPOLE MAGNETS
J. Allinger, G. Danby, H. Foelsche, J. Jackson, A. Prodell, and A. Stevens 1977 6 p refs Presented at 6th Intern. Conf. on Magnet Technol., Bratislava, Czechoslovakia, 29 Aug. 1977
(Contract EY-76-C-02-0016)
(BNL-23211; Conf-770842-11) Avail: NTIS HC A02/MF A02

Superconducting dipole magnets of the windowframe type were constructed and operated successfully. Examples of this type of magnet are the 6T 'model T' magnet, and the 4T 8 degree superconducting bending magnet. The latter magnet operated reliably since October 1973 as part of a proton beam transport, with intensities of typically 8 x 10 to the 12th power protons at 28.5 GeV/c passing through the magnet in a curved trajectory with the proton beam center only 2.0 cm from the beam pipe at both ends and the middle of each of the two units comprising the magnet. The energy in the beam was approximately 40 kJ per 3 microsecond pulse. Targets were inserted in the beam at locations 2m and 5.6m upstream of the first magnet unit to observe the effects of radiation heating. The 8 degree magnet demonstrated ultrastability, curving 3 microsecond thermal pulses delivering up to 1 kJ into the cold magnet at repetition periods as short as 1.3 seconds. ERA

N78-19433# Bendix Corp., Kansas City, Mo.
TEMPERATURE DEPENDENT PROPERTIES OF POTTING MATERIALS Final Report
J. M. Walker Apr. 1976 67 p
(Contract EY-76-C-04-0613)
(BDX-613-1519-Rev-1) Avail: NTIS HC A04/MF A01

The physical properties: mechanical, electrical, and thermal of a general purpose epoxy potting compound, filled with either glass microspheres, aluminum oxide or beta-eucryptite and catalyzed with either an aliphatic amine, a liquid aromatic amine eutectic blend, or a liquid anhydride are discussed. The properties of a CTBN modified epoxy are also included. Twelve formulation-cure cycle combinations were chosen for evaluation. The temperature dependent properties from -65 to 400 F for the 12 combinations are given. ERA

N78-19434# National Bureau of Standards, Washington, D. C.
CALIBRATION OF HIGH-VOLTAGE PULSE MEASUREMENT SYSTEMS BASED ON THE KERR EFFECT Final Report, Jul. 1975 - Oct. 1977
Robert E. Hebner, Jr. and Martin Misakian 16 Sep. 1977 38 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(PB-274333/4; NBSIR-77-1317) Avail: NTIS HC A03/MF A01 CSCL 14B

High voltage pulse measurements performed using systems based on the electrooptic Kerr effect permit state-of-the-art measurements (uncertainties approximately equal to + or - 1 percent). Because the precision of the measurement can be

significantly bettter than the accuracy, techniques to improve the calibration of the system were investigated in two areas: the determination of correction factors to account for differences in environmental factors between the calibration of the system and its use; and the feasibility of calibrating the Kerr system at a number of discrete frequencies and using this calibration for pulse measurement. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N78-19435 Utah Univ., Salt Lake City.
WAVES ON LAMINAR JETS Ph.D. Thesis
Christopher Penn Russell 1977 352 p
Avail: Univ. Microfilms Order No. 77-28062

A theoretical characterization was developed for low amplitude standing waves on a low viscosity nontapered laminar jet. The theoretical and experimental damping coefficients agreed; both showed that the damping of stationary waves is twice as strong as the damping of moving waves at a static surface. However, this theory and the wave length data systematically differed more than the expected experimental error. The following possible causes of these errors were theoretically investigated: viscous and nonviscous finite-amplitude effects, jet-tapering effects; viscous drag of the surrounding gas, and surface tension difference effects along the jet. A comparison of the wave length data with each of these theoretical corrections clearly showed that the surface tension difference effects caused the excess measured error. Dissert. Abstr.

N78-19436 Ohio State Univ., Columbus.
ON THERMAL CONVECTION WITH INTERNAL HEATING IN FLUID LAYERS Ph.D. Thesis
Abdelkhalik Abdelsamie Emara 1977 238 p
Avail: Univ. Microfilms Order No. 77-31862

An experimental study of the transient response of a layer subjected to a step change in internal energy generation has been conducted to determine the time scales for the development and decay of convection. Two types of unsteady convection processes are considered in the study: in the first, the layer is brought to a motionless, isothermal state, and internal energy generation is suddenly started. In the second, steady convection is the initial condition, and internal energy generation is suddenly stopped. For both cases, the time required for the development of the final steady state is determined by measuring the temperature response of the fluid with a small thermocouple probe. A theoretical investigation has been carried out for two dimensional convection in an internally heated fluid layer with the same thermal and hydrodynamic boundary conditions of the experimental study. The computations are restricted to laminar convection. Dissert. Abstr.

N78-19437 Northwestern Univ., Evanston, Ill.
THERMOELASTIC EFFECTS IN THE PARALLEL SLIDING OF SOLID SURFACES SEPARATED BY A VISCOUS LIQUID FILM Ph.D. Thesis
Barunendra Nath Banerjee 1977 188 p
Avail: Univ. Microfilms Order No. 77-32276

Lubricated sliding motion was studied for thermoelastic effects, notably an instability that caused large thermoelastic deformation of a nominally flat surface. A configuration similar to a face seal was used, with one face consisting of a thermal conductor and the other of an insulator. The roles of the pertinent parameters and material properties are delineated. A simple equation is given for the threshold of thermoelastic instability when both faces are initially flat. Dissert. Abstr.

N78-19438 California Univ., Los Angeles.
THE WEINER-HERMITE EXPANSION APPLIED TO DECAYING ISOTROPIC TURBULENCE USING A RENORMALIZED TIME-DEPENDENT BASE Ph.D. Thesis
Henry Dwight Hogge 1977 167 p
Avail: Univ. Microfilms Order No. 77-30917

The problem of decaying isotropic turbulence has been studied using a Wiener-Hermite expansion with a renormalized time dependent base. The expansion is an expansion about Gaussianity. The method followed is to represent the random velocity field as a Wiener-Hermite expansion, substitute the expansion into the Navier-Stokes equations, and deduce differential equations that govern the kernels of the expansion. These equations are integrated to produce the solution to the problem. The theory is completely deductive and uses no ad-hoc modeling approximations. The theory is used to calculate several phenomena of engineering interest: the flatness of turbulence, the Lagrangian autocorrelation function, and the sound radiated by isotropic turbulence. In addition, we propose a model of the energy spectrum and correlation function for large Reynolds number turbulence. Dissert. Abstr.

N78-19439 Houston Univ., Tex.
MISCIBLE DISPLACEMENT OF VISCOUS, NON-NEWTONIAN FLUIDS IN DIFFERENT GEOMETRIES. AN ANALYTICAL APPROACH Ph.D. Thesis
Robert Mariano Beirute 1977 239 p
Avail: Univ. Microfilms Order No. 77-30422

Solutions are given for the displacement occurring between parallel plates and in tubes under conditions of constant flow rate. For tubes, a solution is also given for the case when a constant pressure drop is imposed across the flow field. The analytical approach used relied on principles from the hydrodynamic theory of lubrication. The results showed that the process was characterized in terms of several dimensionless groups which depended on the geometry of the flow field and the density and rheological behavior of the fluids. Computer programs are provided which were used to simulate the displacement process and therefore calculate the displacement efficiency for a given set of conditions. Dissert. Abstr.

N78-19440 Pennsylvania Univ., Philadelphia.
FINITE-DIFFERENCE COMPUTATION OF TURBULENT FREE CONVECTION FROM AN ISOTHERMAL VERTICAL PLATE USING A TWO-EQUATION MODEL OF TURBULENCE Ph.D. Thesis
Shyy-Jong Lin 1977 400 p
Avail: Univ. Microfilms Order No. 77-30227

A two equation, low-Reynolds-number model of turbulence was applied to turbulent natural convection from an isothermal vertical plate. This case differs from forced convection problems in that the thermal and velocity fields are coupled. First a transformation of coordinates which allows growth of the boundary layer thickness was devised. Then the time-averaged equations of conservation for mass, momentum, turbulent kinetic energy and turbulence-energy dissipation were approximated by nonlinear finite difference equations which were implicit in the x direction and in the conservative form. These coupled nonlinear equations were solved by means of a double-loop iterative scheme in which the method of successive relaxation was used in the inner loops and the method of simultaneous relaxation in the outer loop. Dissert. Abstr.

N78-19441 Engineering Sciences Data Unit, London (England).
THE GRAVITATIONAL COMPONENT OF PRESSURE GRADIENT FOR TWO-PHASE GAS OR VAPOUR/LIQUID FLOW THROUGH STRAIGHT PIPES
Aug. 1977 61 p
(ESDU-77016; ISBN-0-85679-187-3) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161

The gravitational component of the pressure gradient is predicted from an assessment of seven separate prediction methods. From these seven, the best for particular circumstances can be quickly identified using specially prepared method selection charts. Several performance charts were prepared: these present statistically derived correction factors that enable the predictions of each method to be aligned with a wide range of experimental data. Besides these seven prediction methods, which were assessed for both vertically upwards flowing mixtures in general and also separately for the important case of vertically upwards

flowing saturated steam/water mixtures, a conversion method is included to allow the gravitational component of pressure gradient to be calculated in both uphill and downhill inclined flows. ESDU

N78-19442 Washington Univ., Seattle.
AN EXAMINATION OF COMBINED FREE AND FORCED CONVECTION PHENOMENA IN A DENSITY-STRATIFIED FLUID Ph.D. Thesis
James Paul Shawcross 1977 263 p
Avail: Univ. Microfilms Order No. 77-28343

The experimental system was used to simulate the atmospheric phenomenon known as the urban heat island. The important experimental results are summarized as follows: (1) a detailed description of the transient and steady-state development of the stationary-medium heat island (2) the development of a correlation for defining the point at which rising thermals were actively generated in the absence of a horizontal velocity; (3) the magnitude of the ambient salinity and temperature fields were correlated with the stationary heat-island circulation stagnation height; (4) the establishment of a definition of the velocity level at which the forced convection of the imposed mean velocity just disrupted the free convection circulation pattern; and the model data was shown to predict observed critical velocity levels in a number of urban areas. Dissert. Abstr.

N78-19443*# Rockwell International Corp., Downey, Calif. Space Div.
FABRICATION AND TEST OF A VARIABLE CONDUCTANCE HEAT PIPE Final Report
A. M. Lehtinen Jan. 1978 78 p refs
(Contract NAS5-24171)
(NASA-CR-156712; SD-78-AP-0011) Avail: NTIS HC A05/MF A01 CSCL 20D

A variable conductance heat pipe (VCHP) with feedback control was fabricated with a reservoir-condenser volume ratio of 10 and an axially grooved action section. Tests of the heat transport capability were greater than or equal to the analytical predictions for the no gas case. When gas was added, the pipe performance degraded by 18% at zero tilt as was expected. The placement of the reservoir heater and the test fixture cooling fins are believed to have caused a superheated vapor condition in the reservoir. Erroneously high reservoir temperature indications resulted from this condition. The observed temperature gradients in the reservoir lend support to this theory. The net result was higher than predicted reservoir temperatures. Also, significant increases in minimum heat load resulted for controller set point temperatures higher than 0 C. At 30 C, control within the tolerance band was maintained, but high reservoir heater power was required. Analyses showed that control is not possible for reasonably low reservoir heater power. This is supported by the observation of a significant reservoir heat leak through the condenser. Author

N78-19444*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A COMPUTER PROGRAM FOR CALCULATING LAMINAR AND TURBULENT BOUNDARY LAYERS FOR TWO-DIMENSIONAL TIME-DEPENDENT FLOWS
Tuncer Cebeci (Calif. State Univ., Long Beach) and Lawrence W. Carr Mar. 1978 62 p refs
(NASA-TM-78470; A-7340) Avail: NTIS HC A04/MF A01 CSCL 20D

A computer program is described which provides solutions of two dimensional equations appropriate to laminar and turbulent boundary layers for boundary conditions with an external flow which fluctuates in magnitude. The program is based on the numerical solution of the governing boundary layer equations by an efficient two point finite difference method. An eddy viscosity formulation was used to model the Reynolds shear stress term. The main features of the method are briefly described and instructions for the computer program with a listing are provided. Sample calculations to demonstrate its usage and capabilities for laminar and turbulent unsteady boundary layers with an external flow which fluctuated in magnitude are presented. Author

N78-19445# Purdue Univ., Lafayette, Ind.
VISUALIZATION STUDY OF VORTICITY AMPLIFICATION IN STAGNATION FLOW
Willy Z. Sadeh, Herbert J. Brauer, and James A. Garrison Oct. 1977 78 p refs Prepared by Colorado State Univ., Fort Collins
(Contract N00014-75-C-1143; Proj. SQUID)
(AD-A048629; SQUID-CSU-1-PU) Avail: NTIS HC A05/MF A01 CSCL 20/4

A visualization study of stagnation flow round a circular cylinder was carried out in order to gain a physical insight into its model put forward by the vorticity-amplification theory. The visualization was conducted at a Reynolds number of 8000 utilizing white smoke composed of titanium dioxide for an approaching flow containing turbulence at scales larger than the neutral wavelength. An in-depth dynamic qualitative apperception of the flow events was obtained by means of motion pictures taken from three different viewpoints. In addition, a frame by frame examination of selected movie strips led to the acquisition of a reasonably quantitative interpretation of the gross flow structure. The analysis of the flow events focused on tracing the temporal and spatial evolution of a cross-vortex tube outlined by the entrained smoke filaments. The visualization supplied striking evidence concerning: (1) the selective stretching of cross-vortex tubes which is responsible for the amplification of vorticity and, hence, of turbulence; (2) the streamwise tilting of stretched cross-vortex tubes; (3) the existence of a coherent array of vortices near the stagnation zone; (4) the interaction of the amplified vorticity with the body laminar boundary layer; and, finally, (5) the growth of a turbulent boundary layer. These are basically the flow characteristics and events advanced by the vorticity-amplification theory. It is thus apparent that the amplification of turbulence in stagnation flow around a bluff body and its effects upon the body boundary layer are satisfactorily explained by the vorticity-amplification theory. Author (GRA)

N78-19446# Douglas Aircraft Co., Inc., Long Beach, Calif.
STATUS OF A HIGHER-ORDER PANEL METHOD FOR NONLIFTING THREE-DIMENSIONAL POTENTIAL FLOW Final Report
John L. Hess 31 Aug. 1977 41 p refs
(Contract N62269-76-C-0377)
(AD-A048623; MDC-J7714-01; NADC-76118-30) Avail: NTIS HC A03/MF A01 CSCL 20/4

The work described in this report consisted of developing a method for calculating potential flow about arbitrary three-dimensional configurations that is a great improvement over existing methods in regard to computational speed and accuracy. The approach adopted is the so-called higher-order formulation of the general three-dimensional 'panel method' that represents a numerical discretization of the fundamental surface-singularity technique for potential flow. The method has been developed for the nonlifting case. A computer program based on this method has been constructed and check-out and is considered operational. This report describes the approach used and presents the results of calculations that have been performed to illustrate the effectiveness of the technique. While the method is described completely, for brevity, detailed formulas are not given for every phase of the calculation. Instead, examples are presented to indicate the level of complexity. Similarly, the previously existing panel method for calculating low-speed flow is described to put the present work in its proper perspective, but details are relegated to the references. Author (GRA)

N78-19447# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
APPLICATION OF THE KARMAN-POHLHAUSEN METHOD TO THE EXTENDED BOUNDARY LAYER EQUATIONS M.S. Thesis
Robert D. Behr Dec. 1977 46 p refs
(AD-A048363; AFIT/GAE/AA/77D-1) Avail: NTIS HC A03/MF A01 CSCL 20/4

An analytical study of the application of the Karman-Pohlhausen method to the extended boundary layer equations at low Reynolds number was made. The extended boundary layer equations were the incompressible Navier-Stokes equations with the assumption of zero normal pressure gradient. A comparison was made between the solutions for the extended boundary layer equations and the boundary layer equations at

several Reynolds numbers for flow over a flat plate, flow near a stagnation point, and flow over a circular cylinder. Author (GRA)

N78-19448# Dynamics Technology, Inc., Torrance, Calif.
AN ANALYTICAL STUDY OF THE EFFECT OF SURFACE ROUGHNESS ON BOUNDARY-LAYER STABILITY Final Report, 29 Nov. 1976 - 30 Sep. 1977
Charles L. Merkle, Kent T. S. Tzou, and Toshi Kubota Oct. 1977 71 p refs
(Contract N00014-77-C-0005)
(AD-A048465; DT-7606-4) Avail: NTIS HC A04/MF A01 CSCL 20/4

The effects of surface roughness on the transition of a laminar boundary layer are basically two-fold: (1) it can distort the mean velocity and temperature profiles thus altering the stability characteristics of the layer and (2) it can induce additional disturbances to the boundary layer which may lead to an earlier transition. Only the first of these effects is considered in this report. Three different types of surface roughness are investigated here; distributed roughness, surface waviness, and a single two-dimensional bump. An analytical model which describes the effect of distributed roughness on the mean flow and its stability is described. This model is further validated by comparison with Achenbach's experimental results and is then applied to the flow about an underwater body in order to illustrate the effects of surface roughness in a more realistic situation. Surface irregularities can play a dominant role in determining the practical limit for the application of boundary-layer control techniques. The present distributed roughness model as incorporated into the TAPS code can provide a reasonable prediction of its effect in the presence of boundary-layer control techniques (shaping, heating, suction) on the transition location for an underwater vehicle. GRA

N78-19449# Defence Research Establishment Suffield, Ralston (Alberta).
DESIGN OF A COMPACT PLENUM CHAMBER FOR SUPPLY OF AIR TO AN ANNULAR SPACE WITH LOW ENERGY LOSSES
D. A. Bayly Dec. 1977 31 p ref
(AD-A049137; DRES-TN-417) Avail: NTIS HC A03/MF A01 CSCL 14/2

This report describes the design of a compact plenum chamber the function of which is to receive air from a rectangular duct and deliver it to an annular space with low energy losses. Turning vanes formed from a single thickness of sheet steel ensure that air leaves the chamber essentially perpendicular to the plane of the annulus. A FORTRAN program is presented which plots the two dimensional development of the turning vane. Author (GRA)

N78-19450# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
OPTICAL INVESTIGATION OF FLOW FIELD GENERATED BY NORMAL SHOCK PROPAGATING INTO A RECTANGULAR DUCT WITH IRREGULAR WALLS M.S. Thesis
Sajid Hussain Dec. 1977 80 p refs
(AD-A048900; AFIT/GAE/AE/77D-5) Avail: NTIS HC A05/MF A01 CSCL 20/4

An optical study of flow field behind a normal shock wave propagating into a rectangular duct with irregular walls was conducted in the AFIT 8 in x 4 in x 20 ft air-air shock tube. Attenuation behavior of the normal shock was also studied. An average upstream Mach number of 1.59 was maintained for all runs. A total of five wall shapes designated as A, B, C, D and E were fabricated and analyzed. Model A, a straight section, served as reference for comparative study of other models. Models B, C and D had identical wave lengths, amplitudes and maximum and minimum flow areas but their ramp angle 0 was 30 deg, 60 deg and 90 deg, respectively. Model E had a saw tooth design and all the other geometrical parameters except the wavelength and the ramp angle were similar to Models B thru D. The wavelength for Model E was half the value of other models and its ramp angle was 63 deg. Disturbance attenuation was determined by measuring its speed across consecutive pairs of pressure transducers located at known distances along the entire length of the test section. Time interval counters measured the time lapse between transducers. Comparative study of all models revealed that disturbance attenuation depends upon the shape of the iregular wall and the two most significant factors in this regard are the ramp angle and the wave length. A higher ramp angle leads to more abrupt area reduction and provides greater attenuation. Shorter wave length provides more inrregularities per unit length, which results in considerable improvement in attenuation phenomenon. Model D, 0 - 90 deg is branded as the most effective design in the present study. GRA

N78-19451# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FLOW CHARACTERISTICS IN A TWO-DIMENSIONAL MULTIPLE-NOZZLE MULTIPLE-DIFFUSER ASSEMBLY M.S. Thesis
Jeffrey L. Kiner Dec. 1977 62 p refs
(AD-A048896; AFIT/GAE/AA/77D-5) Avail: NTIS HC A04/MF A01 CSCL 20/5

Pressure measurements and schlieren photographs were used to study the flow characteristics in a two-dimensional multiple-nozzle multiple-diffuser assembly. The assembly consisted of 29 full nozzles with a half nozzle at each end of the array. The contoured nozzles were designed for an ideal Mach number of 3.23. Fourteen axial diffuser vanes provided 15 diffuser passages. Flow characteristics were studied at five positions of the diffuser entrance plane with respect to the nozzle exit plane. Air at 80F and a maximum of 118 psig was passed through the nozzles into a constant area region then through the diffusers to ambient conditions. The test cavity start and unstart pressures decreased as the diffuser entrance plane approached the nozzle exit plane. A diffuser leading edge in the immediate vicinity of a major alternate nozzle trailing edge shock intersection resulted in a flow instability during cavity start. This instability resulted in a subsonic wake in the test cavity after cavity start. Author (GRA)

N78-19452# Harry Diamond Labs., Adelphi, Md.
FLUIDICS--BASIC COMPONENTS AND APPLICATIONS
James W. Joyce and Richard N. Gottron Oct. 1977 21 p refs
(AD-A049256; HDL-SR-77-6) Avail: NTIS HC A02/MF A01 CSCL 13/7

Since its discovery at Harry Diamond Laboratories in 1959, fluidics has gradually been developed into a viable technology. This report provides a description of fluidic components and systems now in use or ready for use in many applications. The fluidic technology provides sensing, computing, and controlling functions with fluid power through the interactions of fluid streams. Sinc fluidics can perform these functions without mechanical moving parts that will wear out, it has the advantages of simplicity and reliability. Other advantages discussed are the low cost, environmental insensitivity, and safety of fluidic systems. GRA

N78-19453# Illinois Inst. of Tech., Chicago. Dept. of Mechanics, Mechanical and Aerospace Engineering.
CONTROL AND SUPPRESSION OF SWIRLING AND SECONDARY FLOWS IN CONFINED STREAMS Final Technical Report, 1 Jun. 1974 - 15 Jul. 1977
Hassan M. Nagib and Roald A. Wigeland Sep. 1977 11 p refs
(Grant DAHC04-74-G-0160)
(AD-A049193; IIT-FLUIDS/HEAT TRANS-77-3; ARO-12290.7-E; ARO-ITR-77-3) Avail: NTIS HC A02/MF A01 CSCL 13/13

The main objectives are not only to develop recommended procedures for control of large scale swirling and secondary flows, but also to extract from empirical observations general concepts which design and test engineers could adapt for 'tailoring and manipulating' their own special flows with different rotational characteristics. Several typical rotational flows were generated and superimposed on the flow through the test section. Careful calibration was carried out using hot-wire anemometers, and miniature vane-vorticity indicators. These flows represent the basic target conditions to be controlled by inserting various flow manipulators' honeycombs, screens and perforated plates. Comparison of the characteristics of the flow downstream of the manipulators (e.g., distribution of streamwise vorticity) to the original test flows provides a measure of the efficacy of the manipulators in suppressing large scale vorticity as well as clues

to dominant mechanisms of the flow transformations.
Author (GRA)

N78-19454# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics/Logistics Dept.
A DISCRETE VORTEX SIMULATION OF A TWO-DIMENSIONAL SHEAR LAYER WITH PREDICTION OF THE HYDRODYNAMIC NOISE
Walter J. Grabowski and John G. Telste Dec. 1977 38 p refs
(AD-A049271; CMLD-77-26) Avail: NTIS HC A03/MF A01 CSCL 20/4

A numerical simulation of the two-dimensional shear layer occurring at the interface of two streams of different velocity is described. The shear layer is represented by a large number of discrete vortices and is allowed to evolve in accordance with the velocity potential of the vortices. It is found that the model effectively simulates the large-scale evolution of the layer. The model, however, is found to be inadequate for predicting the hydrodynamic sound generated in the shear layer because small-scale vortex motion plays a major role in acoustic prediction. Author (GRA)

N78-19455# California Univ., Livermore. Lawrence Livermore Lab.
METERING LOW-QUALITY STEAM-WATER FLOWS
C. T. Crowe and H. Weiss 26 Apr. 1977 33 p refs
(Contract W-7405-eng-48)
(UCRL-52271) Avail: NTIS HC A03/MF A01

The simultaneous measurement of mass flow rate and quality of low quality steamwater flows was of primary interest in evaluating and monitoring the flow from geothermal resources. The experience acquired at LLL in attempting to perform such measurements with a double flash arrangement using orifices and venturis was related. The mass flow correlations proposed in the literature were reviewed and a new correlation based on the energy equation was introduced. The data were presented and evaluated in light of these correlations. ERA

N78-19456# Brookhaven National Lab., Upton, N. Y.
HYDRODYNAMIC MODEL OF TWO-PHASE PIPE FLOW
U. S. Rohatgi, S. V. Lekach, and G. Srikantiah 1977 13 p refs Presented at Thermal Reactor Safety Meeting, Sun Valley, Idaho, 31 Jul. 1977
(Contract EY-76-C-02-0016)
(BNL-NUREG-23105; Conf-770708-11) Avail: NTIS HC A02/MF A01

A main objective of the advanced computer code development effort is to attain economy in computing time while retaining accuracy of results. With this objective in mind, a lumped parameter model has been developed for describing transient two phase flow in a pipe on the basis of the four conservation equations of the drift flux model. In order to assess computing speed and accuracy of the lumped parameter approach, a discrete parameter method has also been developed based on the same basic model. In the lumped parameter approach, the governing partial differential equations have been reduced to ordinary differential equations in the time coordinate by use of shape functions or profiles which describe the spatial distribution of the variables within the component. In the discrete parameter method, a first order implicit Euler formulation for the governing equations has been used to develop a computer algorithm capable of solving problems with implicit boundary conditions. ERA

N78-19457# Oak Ridge National Lab., Tenn.
HEATING5: AN IBM 360 HEAT CONDUCTION PROGRAM
W. D. Turner, D. C. Elrod, and I. I. Siman-Tov Mar. 1977 119 p refs
(Contract W-7405-eng-26; Contract NRC-INA-40-545-75)
(ORNL-CSD/TM/15) Avail: NTIS HC A06/MF A01

HEATING5 is designed to solve steady-state and/or transient heat conduction problems in one, two, or three dimensional Cartesian or cylindrical coordinates or one dimensional spherical coordinates. The thermal conductivity, density, and specific heat may be both spatially and temperature dependent. The thermal conductivity may be anisotropic. Heat generation rates may be dependent on time, temperature and position, and boundary temperatures may be time dependent. The boundary conditions, which may be surface-to-boundary or surface-to-surface, may be fixed temperatures or any combination of prescribed heat flux, forced convection, natural convection, and radiation. The boundary condition parameters may be time and/or temperature dependent. The mesh spacing can be variable along each axis. The maximum number of lattice points can be easily adjusted to fit the problem and the computer storage requirements. ERA

N78-19458# Oak Ridge Gaseous Diffusion Plant, Tenn.
PRESSURE DROP AND HEAT TRANSFER CHARACTERISTICS OF REFRIGERANT-114 BOILING IN A HORIZONTAL TUBE
W. R. Brock Oct. 1977 332 p refs
(Contract W-7405-eng-26)
(K-1897) Avail: NTIS HC A15/MF A01

The two phase pressure drop and heat transfer characteristics of R-114 flowing in a horizontal tube were studied. Flow regime studies were also performed as part of this effort. No single method for predicting flow regime was found to be accurate over the range of conditions studied. Four correlations gave promising results when compared to the experimental frictional pressure drop data. ERA

N78-19459# Northwestern Univ., Evanston, Ill. Dept. of Chemical Engineering.
SIMULATION OF BOILING POOLS WITH INTERNAL HEAT SOURCES BY GAS INJECTION
A. C. H. Luk, A. Ganguli, and S. G. Bankoff 29 Jul. 1977 32 p refs
(Contract EY-76-S-02-2554)
(COO-2554-6) Avail: NTIS HC A03/MF A01

Heat transfer from the sides and bottom of an open non-boiling liquid pool with spatially uniform internal gas injection was studied experimentally, both in transient and in steady state. The results were compared with experimental data for a boiling pool without permanent gas injection. Typical Nusselt number versus Reynolds number plots showed that heat transfer rates were much higher in the gassy pool due to more efficient circulation. A correction was applied to estimate the surface evaporation effect under boiling conditions. Bubble size and distribution effects controlled the heat transfer rates. Vertical void fraction profiles were inferred from local static pressure measurements. A modified Grashof number, in terms of the average void fraction, was also used to correlate the data for horizontal heat flow. The bottom and side heat loss rates were about equal, which would indicate that the pool might retain its shape as it sinks into the support material. ERA

N78-19460# Oak Ridge National Lab., Tenn.
VAPOR LOCKING AS A LIMITATION TO THE STABILITY OF COMPOSITE CONDUCTORS COOLED BY BOILING HELIUM
J. W. Lue, J. R. Miller, and L. Dresner 1977 18 p refs Presented at the Cryog. Eng. Conf., Boulder, Colo., 2 Aug. 1977
(Contract W-7405-eng-26)
(CONF-770801-18) Avail: NTIS HC A02/MF A01

Vapor locking was observed to limit the stability of superconductors in narrow channels. The limitation is consistent with an analysis based on reduction of cooled surface by vapor formation. In very long channels however, it was found that stability increases. When the superconductor inside long sheathed sections recovers from the resistive state, it recovers faster than in the open section. This is believed due to increase of the heat transfer coefficient and heat capacity caused by pressure build up and relief inside the sleeve. ERA

N78-19461# Ames Lab., Iowa.
INTERFACIAL FLOW PATTERNS ON A STATIC LIQUID DROP WITH FORCED INTERNAL CIRCULATION M.S. Thesis
F. F. Poonawalla Feb. 1977 57 p refs
(Contract W-7405-eng-82)
(IS-T-754) Avail: NTIS HC A04/MF A01

In the absence of interfacial turbulence and mass transfer, the interfacial motion on a forming liquid drop results purely from shear transmitted by internal motion of the fluid inside the

drop, just underneath the interface. The shear induced motion in the interface was observed by placing light reflecting hollow glass beads on the interface of a static liquid drop with forced internal circulation and photographing their motion. Two, four, and six symmetrical flow patterns were observed on the interface when the Reynolds number based on the density and viscosity of the drop fluid, the velocity through nozzle, and the nozzle diameter was varied over a range of 8 to 34, 60 to 150, and 220 to 270, respectively. The shape of each of the two pattern flows was approximately elliptical, while that of the four and six pattern flow was approximately triangular. The gradual change from two to four, and four to six patterns occurred in the range of Reynolds number 34 to 60, and 150 to 220, respectively. ERA

N78-19462# Bettis Atomic Power Lab., West Mifflin, Pa.
PRESSURE PULSE TEST RESULTS AND QUALIFICATION OF THE FLASH-34 FLEXIBLE STRUCTURAL MEMBER MODEL WITH A SURGE TANK ATTACHED TO THE TEST VESSEL (LWBR DEVELOPMENT PROGRAM)
R. E. Schwirian Aug. 1977 49 p refs
(Contract EY-76-C-11-0014)
(WAPD-TM-1290) Avail: NTIS HC A03/MF A01

Pressure pulse tests were conducted with both solid and flexible test sections installed in a test vessel filled with room temperature water. A surge tank whose volume was approximately equal to that of the test vessel with the test section installed was connected to the test vessel by a 1/8 inch I.D., 8 inch long surge line. Pressure pulses of magnitude up to 1275 psid and durations from 4.6 to 55.8 msec were generated in the test vessel with a drop hammer and piston pulse generator. FLASH-34 calculations show good agreement with the test data. In particular, FLASH-34 accurately predicts: (1) the decrease in peak pressure and the increase in pulse duration due to the presence of a flexible test section; (2) the time delay between the occurrence of the pressure pulse in the test vessel and its arrival in the surge tank; and (3) the magnitudes of the transient pressure differences between the test vessel and surge tank caused by the time delay. ERA

N78-19463# Los Alamos Scientific Lab., N. Mex.
POST: A POSTPROCESSOR COMPUTER CODE FOR PRODUCING THREE-DIMENSIONAL MOVIES OF TWO-PHASE FLOW IN A REACTOR VESSEL
K. A. Taggart and D. R. Liles Aug. 1977 77 p
(Contract W-7405-eng-36)
(LA-NUREG-6954-MS) Avail: NTIS HC A05/MF A01

The development of the TRAC computer code for analysis of LOCAs in light-water reactors involves the use of a three-dimensional (r-theta-z), two-fluid hydrodynamics model to describe the two-phase flow of steam and water through the reactor vessel. One of the major problems involved in interpreting results from this code is the presentation of three dimensional flow patterns. The purpose of the report is to present a partial solution to this data display problem. A first version of a code which produces three dimensional movies of flow in the reactor vessel has been written and debugged. This code (POST) is used as a postprocessor in conjunction with a stand alone three dimensional two-phase hydrodynamics code (CYLTF) which is a test bed for the three dimensional algorithms to be used in TRAC. ERA

N78-19464# Los Alamos Scientific Lab., N. Mex.
HEAT TRANSFER AND FLOW FRICTION IN FINE POROUS MEDIA
W. A. Steyert Sep. 1977 13 p refs
(Contract W-7405-eng-36)
(LA-6912-MS) Avail: NTIS HC A02/MF A01

Fluid flow friction factors and heat transfer coefficients are reported for fine screens and for packed fine copper spheres. The fluids used are nitrogen and helium gas and water. The observed values do not deviate greatly from the values determined by scaling previous measurements taken from much coarser structures. ERA

N78-19789*# Boeing Co., Seattle, Wash.
COMPUTATIONAL FLUID DYNAMICS (CFD): FUTURE ROLE AND REQUIREMENTS AS VIEWED BY AN APPLIED AERODYNAMICIST
H. Yoshihara *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 132-142 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

N78-19790*# Sandia Labs., Albuquerque, N. Mex.
COMPUTATIONAL REQUIREMENTS FOR THREE-DIMENSIONAL FLOWS
F. G. Blottner *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 145-153 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

N78-19792*# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
CRITICAL ISSUES IN VISCOUS FLOW COMPUTATIONS
W. L. Hankey *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 168-175 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

N78-19793*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VISCOUS FLOW SIMULATION REQUIREMENTS
Julius E. Harris *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 176-208 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

N78-19794*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTING VISCOUS FLOWS
J. D. Murphy *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 209-220 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

N78-19799*# Texas Univ., Arlington.
A DUAL ASSAULT UPON TURBULENCE
F. R. Payne *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 260-266 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N78-19465* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPARATUS FOR MEASURING A SORBATE DISPERSED IN A FLUID STREAM Patent
Otis L. Updike, inventor (to NASA) (Va. Univ., Charlottesville) Issued 25 Oct. 1977 10 p Filed 19 Sep. 1975 Supersedes N75-32389 (13 - 23 p 2914) Sponsored by NASA
(NASA-Case-ARC-10896-1; US-Patent-4,055,072; US-Patent-Appl-SN-615030; US-Patent-Class-73-23) Avail: US Patent Office CSCL 14B

A sensitive, miniature apparatus was designed for measuring low concentrations of a sorbate dispersed in a fluid stream. The device consists of an elongated body having a surface capable of sorbing an amount of the sorbate proportional to the concentration in the fluid stream and propagating acoustic energy along its length. The acoustic energy is converted to an electrical output signal corresponding to the concentration of sorbate in the fluid stream. The device can be designed to exhibit high sensitivity to extremely small amounts of sorbate dispersed in a fluid stream and to exhibit low sensitivity to large amounts of sorbate. Another advantage is that the apparatus may be formed

in a microminiature size and at a low cost using bath microfabrication technology. Official Gazette of the U.S. Patent Office

N78-19466* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AUTOMATIC FLUID DISPENSER Patent
Peter C. Sakellaris, inventor (to NASA) Issued 25 Oct. 1977 6 p Filed 8 Oct. 1975 Supersedes N75-32766 (13 - 23, p 2963)
(NASA-Case-ARC-10820-1; US-Patent-4,055,147; US-Patent-Appl-SN-620675; US-Patent-Class-119-72.5; US-Patent-Class-119-51.11; US-Patent-Class-137-624.11)
Avail: US Patent Office CSCL 14B

Fluid automatically flows to individual dispensing units at predetermined times from a fluid supply and is available only for a predetermined interval of time after which an automatic control causes the fluid to drain from the individual dispensing units. Fluid deprivation continues until the beginning of a new cycle when the fluid is once again automatically made available at the individual dispensing units.
Official Gazette of the U.S. Patent Office

N78-19467 Case Western Reserve Univ., Cleveland, Ohio.
ELECTRONIC HETERODYNE RECORDING AND PROCESSING OF OPTICAL HOLOGRAMS USING PHASE MODULATED REFERENCE WAVES Ph.D. Thesis
Arthur John Decker 1977 98 p
Avail: Univ. Microfilms Order No. 77-30981

A theory is developed of electronically recorded holograms formed with phase modulated reference beams. Conditions are determined where the signals resulting from the self-interference terms and cross-interference terms of the hologram can be placed in nonoverlapping bands. A hologram constructed from the signals is shown to be an off-axis reference beam hologram even though the hologram is recorded with coaxial object and reference beams. The phase modulation permits several holograms to be constructed from a single signal. Phase modulation is shown to permit linear and nonlinear processing of an object wave. Optical processing is shown to be augmented by electronic scale transformations. A procedure for the use of scale transformations in threedimensional imaging is derived. Finally, the possibility of increasing the resolution of a scanned system sufficiently to permit the use of an off-axis reference beam is discussed. Dissert. Abstr.

N78-19468*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MANUFACTURING TECHNIQUES FOR GRAVITY PROBE B GYROSCOPES
John R. Rasquin Feb. 1978 18 p refs
(NASA-TM-78159) Avail: NTIS HC A02/MF A01 CSCL 14B

Additional and improved techniques for the manufacture of Gravity Probe B gyroscopes are reported. Improvements discussed include the redesign of the housings, new techniques for indentation of the electrode surfaces, and a new rotor ball lapping machine. These three items represent a significant improvement in operation of the gyroscope and also make possible the fabrication of a gyroscope which will meet flight requirements.
Author

N78-19469*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
SCIENTIST/AMPS EQUIPMENT INTERFACE STUDY Final Report
Hugh R. Anderson Sep. 1977 59 p
(Contract NAS8-31679)
(NASA-CR-156699) Avail: NTIS HC A04/MF A01 CSCL 14B

The principal objective was to determine for each experiment how the operating procedures and modes of equipment onboard shuttle can be managed in real-time or near-real-time to enhance the quality of results. As part of this determination the data and display devices that a man will need for real-time management are defined. The secondary objectives, as listed in the RFQ and technical proposal, were to: (1) determine what quantities are to be measured (2) determine permissible background levels (3) decide in what portions of space measurements are to be made (4) estimate bit rates (5) establish time-lines for operating the experiments on a mission or set of missions and (6) determine the minimum set of hardware needed for real-time display. Experiment descriptions and requirements were written. The requirements of the various experiments are combined and a minimal set of joint requirements are defined. Author

N78-19470*# Lumin, Inc., Tuscaloosa, Ala.
DUAL HOLOGRAM DESIGN STUDY Final Report
Hua-Kuang Liu Feb. 1978 47 p refs
(Contract NAS8-32147)
(NASA-CR-150596; Rept-129-78) Avail: NTIS HC A03/MF A01 CSCL 14E

A phase modulated triple exposure technique was incorporated into a holographic nondestructive test (HNDT) system. The technique was able to achieve a goal of simultaneously identifying the zero-order fringe and determining the direction of motion (or displacement). Basically, the technique involves the addition of one more exposure, during the loading of the tested object, to the conventional double-exposure hologram. A phase shifter is added to either the object beam or the reference beam during the second and third exposure. Theoretical analysis with the assistance of computer simulation illustrated the feasibility of implementing the phase modulation and triple-exposure in the HNDT systems. Main advantages of the technique are the enhancement of accuracy in data interpretation and a better determination of the nature of the flaws in the tested object.
Author

N78-19471# Radio Corp. of America, Camden, N. J. Information Processing and Recording Systems.
ULTRA WIDEBAND DIGITAL RECORDING TECHNIQUES Final Technical Report, May 1976 - Jul. 1977
Oliver E. Bessette and Leroy W. Ferber Griffiss AFB, N. Y. RADC Nov. 1977 124 p refs
(Contract F30602-76-C-0183)
(AD-A048452; RADC-TR-77-356) Avail: NTIS HC A06/MF A01 CSCL 14/3

Design, modifications, test, evaluation and analysis were made on a predistortion encoder, record equalizer, HDMR head, playback preamplifier, delay modulation detector, and computer tape transport. Performance and performance limits were analyzed and applied to the modulation and coding, tape and head-tape interface, and magnetic heads technologies. Author (GRA)

N78-19472# Iowa Inst. of Hydraulic Research, Iowa City.
AN IMPROVED IOWA SEDIMENT CONCENTRATION ANALYZER
John Glover Oct. 1977 36 p refs
(Contract DACW72-7T-M-0229)
(AD-A049175; IIHR-209) Avail: NTIS HC A03/MF A01 CSCL 08/8

The Iowa Sediment Concentration Measuring System (ISCMS) is an electro-optical instrument designed for measuring suspended sediment concentrations in situ. The instrument employs a small light source and sensor which responds to particles interrupting the light from the sensor. The improved model has a higher carrier frequency to eliminate the influence of particle velocity on mean measurements and to improve the high-frequency response of the system. This change in carrier frequency required that 11 circuits be redesigned. A particle generator, consisting of small partially drilled holes in a rotating disk, was used to evaluate instrument performance. The results of tests conducted with this generator showed that mean concentration measurements for particle velocities as high as 7.3 m/s were unaffected by particle velocity. Also, the -3-db upper frequency limit occurs at a particle velocity greater than 3.7 m/s. Author (GRA)

N78-19473# Naval Research Lab., Washington, D. C.
A VERSATILE SUPERCONDUCTING MAGNETOMETER/GRADIOMETER SYSTEM Final Report
M. Nisenoff and S. A. Wolf Oct. 1977 26 p refs
(AD-A049117; AD-E000046; NRL-MR-3618) Avail: NTIS HC A03/MF A01 CSCL 20/3

A versatile superconductive magnetometer/gradiometer system was designed and procured from a commercial vendor. A number of magnetic field sensing (pick-up) loops are mounted on a common substrate block and connected through a switching network to a single SQUID sensor. By suitably connecting these coils, it is possible to measure a component

of the magnetic field of interest with an instrument noise level of 1.1 x 10(-14) tesla rms per root hertz or at a reduced sensitivity range with an instrument noise level of 1.3 x10(-13) tesla rms per root hertz. In addition, several of the coils can be connected in opposition to measure the diagonal component of the gradient (dH sub i/dX sub i) of the field of interest with an instrument noise level of 1.2 x 10(-15) tesla rms per cm per root hertz. The dewar and probe assembly can be tilted in order to monitor either the horizontal or the vertical field component or (diagonal) gradient component of the field of interest.

Author (GRA)

N78-19474# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ACCD RADIOMETER FOR USE IN GEODSS
Frank L. McNamara and William E. Krag 4 Nov. 1977 49 p refs
(Contract F19628-78-C-0002)
(AD-A049255; ETS-25; ESD-TR-77-280) Avail: NTIS HC A03/MF A01 CSCL 09/5

Proposed is a CCD radiometer for application in the GEODSS Program. An analysis is made of the predicted performance in a field environment. The results are compared for a variety of satellite brightnesses and levels of night sky background with the present single cell GaAs radiometer undergoing tests at the GEODSS Experimental Test Facility at White Sands Missile Range, New Mexico and with the Robinson-Wampler multi-channel radiometer in use at Lick Observatory, University of California, Santa Cruz, California, and the McDonald Observatory, University of Texas, Fort Davis, Texas. The comparison indicates that the CCD radiometer allows the optical signature of objects to be determined with higher accuracy and improved time resolution, and permits a more efficient utilization of telescope time.

Author (GRA)

N78-19475# California Univ., Livermore. Lawrence Livermore Lab.
EVALUATION OF METAL-FOIL STRAIN GAGES FOR CRYOGENIC APPLICATION IN MAGNETIC FIELDS
H. S. Freynik, Jr., D. R. Roach, D. W. Deis, and D. G. Hirzel 8 Jul. 1977 20 p refs Presented at Cryogenic Eng. Conf., Boulder, Colo., 2-5 Aug. 1977 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-79202; Conf-770801) Avail: NTIS HC A02/MF A01

The effect of mechanical stress on the current carrying capacity of Nb3Sn was of major importance in determining the feasibility of constructing large magnets with this material. A typical experiment for determining such data involves the measurement of critical current versus magnetic field while the conductor was being mechanically strained to various degrees. Techniques were developed for the current and field measurements, but much less so for the accurate measurement of strain at liquid helium temperature in a high magnetic field. A study was made of commercial, metal foil strain gages for use under these conditions. The information developed can be applied to the use of strain gages as diagnostic tools in superconducting magnets. ERA

N78-19476# Brookhaven National Lab., Upton, N. Y.
NEW DEVELOPMENTS ON TRANSITION RADIATION DETECTORS USING SUPERCONDUCTING GRANULES
L. C. L. Yuan 1977 10 p refs Presented at the Intern. Symp. on Transition Radiation of High Energy Particles, Yereuan, Armenia, USSR, 12-17 May 1977
(Contract EY-76-C-02-0016)
(BNL-23234; Conf-770596-1) Avail: NTIS HC A02/MF A01

Methods of transition radiation detection were investigated. In two, the flipping of one single granule from the superconducting state to the normal state was detected. Methods studied include: frequency measuring method, superconducting quantum interference device, and the pulse method with low noise amplifier system. ERA

36 LASERS AND MASERS

Includes parametric amplifiers.

N78-19477 Case Western Reserve Univ., Cleveland, Ohio.
STARK EFFECTS IN OPTICALLY PUMPED CH3OH FIR INFRARED LASER Ph.D. Thesis
Kee Pun Koo 1977 110 p
Avail: Univ. Microfilms Order No. 77-30996

The spectroscopic background including the Stark properties necessary for the understanding of a CH3OH FIR laser system is reviewed. A model was developed for a Stark-tuned optically pumped CH3OH FIR laser using a rate equation approach. Observed Stark tuning effects include: (1) frequency shifting of CH3OH absorption line, (2) frequency shifting of the FIR laser line and (3) amplitude modulation of the FIR laser output.

Dissert. Abstr.

N78-19478 California Univ., Berkeley.
BROADENING MECHANISMS IN SEMICONDUCTOR (GaAs) LASERS: LIMITATIONS TO SINGLE MODE EMISSION Ph.D. Thesis
Benjamin Zee 1977 246 p
Avail: Univ. Microfilms Order No. 77-31602

A model for the nature of line broadening was developed, explaining the incomplete saturation of spontaneous emission above threshold, the energy dependence of the radiative lifetime spectra, and the observation on homogeneous and inhomogeneous broadening behavior of semiconductor lasers operated with an external cavity. The agreement between the predictions and experimental observations lends credence to the model. The asymptotic nature of threshold is explained, and the increasing power and coherent nature of the emission as the gain approaches the loss are discussed. The observed multimode spectra in the vicinity of threshold reflects power sharing among the modes. The gain profile for various dopings and injections and the power emission spectra of the modes as a function of their gain were calculated. Dissert. Abstr.

N78-19479*# Old Dominion Univ., Norfolk, Va. Dept. of Physics and Geophysical Sciences.
THE EVALUATION OF A HgCdTe PHOTOMIXER WITH A TUNABLE DIODE LASER (TDL) AND THE EVALUATION OF TDL'S AS A LOCAL OSCILLATOR IN A HETERODYNE DETECTION SYSTEM Final Report, 1 Jul. 1977 - 31 Mar. 1978
Charles N. Harward and E. C. Kindle Nov. 1977 54 p refs (Grant NsG-1197)
(NASA-CR-155784; PGSTR-AP77-63) Avail: NTIS HC A04/MF A01 CSCL 20E

Heterodyne systems would be much more versatile if a broadly tunable laser, such as a semiconductor diode laser (TDL), could be used as the local oscillator (LO). Previous studies have shown that while a TDL can be used as an LO, the TDL lack sufficient power to cause the signal-to-noise ratio to be shot noise limited. The heterodyne system with a HgCdTe photodiode as the LO was characterized and the beat frequency response of the heterodyne systems was mapped out. Author

N78-19480*# Hughes Research Labs., Malibu, Calif.
EXCIMER LASERS Final Report, 30 May 1975 - 10 Jun. 1976
A. J. Palmer, L. D. Hess, R. R. Stephens, and D. M. Pepper Nov. 1977 129 p refs
(Contract NAS3-19707)
(NASA-CR-155949) Avail: NTIS HC A07/MF A01 CSCL 20E

The results of a two-year investigation into the possibility of developing continuous wave excimer lasers are reported. The program included the evaluation and selection of candidate molecular systems and discharge pumping techniques. The K Ar/K2 excimer dimer molecules and the xenon fluoride excimer molecule were selected for study; each used a transverse and capillary discharges pumping technique. Experimental and theoretical studies of each of the two discharge techniques applied to each of the two molecular systems are reported. Discharge stability and fluorine consumption were found to be the principle impediments to extending the XeF excimer laser into the continuous wave regime. Potassium vapor handling problems were the principal difficulty in achieving laser action on the K Ar/K2 system. Of the four molecular systems and pumping techniques

explored, the capillary discharge pumped K Ar/K2 system appears to be the most likely candidate for demonstrating continuous wave excimer laser action primarily because of its predicted lower pumping threshold and a demonstrated discharge stability advantage. Author

N78-19481*# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
STUDY, OPTIMIZATION, AND DESIGN OF A LASER HEAT ENGINE Final Report
12 Jan. 1978 160 p refs
(Contract NAS2-9668)
(NASA-CR-152104; MSNW-78-1082-1) Avail: NTIS HC A08/MF A01 CSCL 20E

Laser heat engine concepts, proposed for satellite applications, were analyzed to determine which engine concepts best meet the requirements of high efficiency (50 percent or better) continuous operation in space. The best laser heat engine for a near-term experimental demonstration, selected on the basis of high overall operating efficiency, high power-to-weight characteristics, and availability of the required technology, is an Otto/Diesel cycle piston engine using a diamond window to admit CO2 laser radiation. The technology with the greatest promise of scaling to megawatt power levels in the long term is the energy exchanger/gas turbine combination. Author

N78-19482*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEMPERATURE DEPENDENCE OF FAR-INFRARED (FIR) LASER OUTPUT POWER
Nabil M. Lawandy Feb. 1978 19 p Submitted for publication
(NASA-TM-78080; G7802-14) Avail: NTIS HC A02/MF A01 CSCL 20E

The temperature dependence of the small signal gain and saturation power were derived using temperature dependent rates in a four level model. With this approach, an expression was developed for the output power of a far infrared oscillator as a function of temperature. The results are valid for constant pressure and volume in the regime of homogeneous broadening of the laser transition. It is shown that the small signal gain increases with temperature, whereas the saturation power decreases with temperature. This has the overall effect of enhancing laser output power for moderate temperature increases. It is also shown that the output should drop as the temperature is lowered. Author

N78-19483# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
MULTIPLE-CIRCUIT PULSE GENERATOR FOR HIGH-REPETITION-RATE RARE GAS HALIDE LASERS
C. P. Wang 15 Mar. 1978 25 p refs
(ATR-78(9441)-1) Avail: NTIS HC A02/MF A01

A multiple-circuit high-pulse-repetition-frequency (PRF) pulse generator for the pumping of rare gas halide lasers is reported. With this multiple-circuit design, high PRF can be achieved by the use of existing low PRF thyratron switches and capacitors. A two-circuit pulse generator was constructed, and its performance is described. By means of this pulse generator and a blowdown-type fast transverse-flow system, high PRF laser action in XeF was obtained; typically, 6 mJ/pulse at 1 kHz or 6 W average power. High PRF laser action in N2 was observed also. Author

N78-19484# Hughes Aircraft Co., Culver City, Calif. Electro-Optical and Data Systems Group.
THE 4.3 MICROMETER LASER DEMONSTRATION EXPERIMENT Interim Report, 29 Jun. - 30 Sep. 1977
Philip K. Baily and Jack Finzi Oct. 1977 37 p refs
(Contract N00173-77-C-0174; ARPA Order 2062)
(AD-A048550; HAC-P77-490; HAC-REF-D9802) Avail: NTIS HC A03/MF A01 CSCL 20/5

The possibility of converting multiline CW DF chemical laser radiation to single line CW 4.3 micrometer radiation by means of an Optical Resonance Pumped Transfer Laser (ORTL) is investigated. The ORTL medium consists of a DF and CO2 mixture and a suitable diluent. The optically pumped DF collisionally transfers its vibrational excitation to the CO2. This program is concerned with a demonstration of 4.3 micrometers oscillation between the (00 deg 1) and ground state CO2 levels. During this reporting period, a laser demonstration experiment has been designed and hardware is being assembled. DF and CO2 fluorescence experiments were performed as a guide to the experimental design. The experiments and results are discussed. The results indicate a strong probability of success for the demonstration experiment. Author (GRA)

N78-19485# Cornell Univ., Ithaca, N. Y.
RESEARCH ON MOLECULAR LASERS Final Report, 1 Oct. 1968 - 30 Sep. 1976
George J. Wolga, Terrill A. Cool, Simon H. Bauer, and Ross A. McFarlane 31 Aug. 1977 24 p refs
(Contract N00014-76-C-0426; ARPA Order 2062)
(AD-A048643) Avail: NTIS HC A02/MF A01 CSCL 20/5

The broad objectives of this research were to provide quantitative information concerning molecular and chemical lasers. The parameters dealt with were: new laser transitions and pumping schemes; laser gain and saturation parameters; measurements of relaxation and energy transfer between the translational, rotational, vibrational, and electronic modes of prominent laser molecules. GRA

N78-19486# United Technologies Research Center, East Hartford, Conn.
LASER PROPAGATION EXPERIMENTS AEROSOL AND STAGNATION ZONE EFFECTS Final Technical Report, 19 Oct. 1976 - 19 Apr. 1977
M. C. Fowler, J. R. Dunphy, and David C. Smith Aug. 1977 117 p refs
(Contract N00173-76-C-0157; ARPA Order 2439)
(AD-A048642; UTRC/R77-922578-13) Avail: NTIS HC A06/MF A01 CSCL 20/5

This final technical report describes the result of two programs concerned with high power laser propagation through the atmosphere that are particularly important to the Navy high energy laser program. The first study deals with an experimental laboratory simulation of moving stagnation zones a problem which can be quite serious for the Navy application. The second study is the propagation and non-linear interaction of a high intensity laser with water droplets or fog, again in a laboratory simulation experiment under realistic conditions. The experimental results are given in terms of non-dimensional parameters which can be interpreted in terms of real outside atmospheric conditions. In addition, the results are modeled by simplified analytic expressions which should find wide use in systems analysis of Navy scenarios. GRA

N78-19487# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
LASER AUTOREFLECTANCE M.S. Thesis
Charles W. Martin Dec. 1977 109 p refs
(AD-A048362; AFIT/GEP/PH/77D-7) Avail: NTIS HC A06/MF A01 CSCL 20/6

The autoreflectance peak in the angular reflectance distribution of laser radiation from nonspecular surfaces is investigated. An experimental apparatus using a He-Ne laser operating at 632.8 nm is described. This apparatus allowed measurement of the reflectance from a surface from 0 to 90 deg from the autoreflectance direction in the plane of incidence. The reflectance measurements from surfaces of smoked MgO, a MgCO3 block, a nonspecular gray paint, a pigmented, polymeric bead paint, and 3M Company Black Velvet paint are presented. Each of the five surfaces are shown to exhibit an autoreflectance peak and the dependence of the peak magnitude on measurement distance and the incidence angle is measured. A theoretical reflectance equation for coherent, collimated radiation incident on a surface of spherical particles is developed, and the results of this equation are shown to compare to the measured reflectance data within a few percent. Author (GRA)

N78-19488# Aerospace Corp., El Segundo, Calif. Ivan A. Getting Labs.
BOUNDARY LAYER EFFECTS IN CHEMICAL LASER NOZZLE INLET Interim Report
Harold Mirels and Shaowen W. Liu 8 Nov. 1977 32 p refs
(Contract F04701-77-C-0078)
(AD-A048447; TR-0078(3725)-1; SAMSO-TR-77-212) Avail: NTIS HC A03/MF A01 CSCL 20/5

Fluorine atom recombination and heat loss to the wall are investigated in the inlet and supersonic expansion region of typical CW chemical laser nozzles. It is concluded that the major losses occur in the inlet section. Expressions given for estimating these losses are based on zero pressure gradient flows with unit Prandtl and Schmidt numbers. For typical geometries, a plenum temperature T sub o = 1500 K, and plenum pressures in the range 1 < or = p sub o, atm < or = 10, the reduction of total enthalpy at the downstream end of the inlet section varied from about 10% to 30%. The reduction within the actual boundary layer mass flow is approximately 40% for a boundary layer thickness defined such that U/u sub e = 0.9, where u and u sub e denote local and free-stream velocities, respectively. It is concluded that these losses should be considered when CW chemical laser performance is being estimated or analyzed.
Author (GRA)

N78-19489# Texas Univ. at Dallas, Richardson. Center for Quantum Electronics.
CHARGE TRANSFER PUMPING OF THE HELIUM NITROGEN LASER AT ATMOSPHERIC PRESSURES IN AN ELECTRICAL AVALANCHE DISCHARGE Technical Report, 1 Jan. - 31 Oct. 1977
Carl B. Collins, J. M. Carroll, and K. N. Taylor 31 Oct. 1977 26 p refs
(Contract N00014-77-C-0168; RR01107)
(AD-A048386; UTDP-ML-07; TR-1) Avail: NTIS HC A03/MF A01 CSCL 20/5

An Atmospheric Electrical Avalanche (AEA) laser, stabilized by displacement current preionization, has been developed to support the study of the collisional pumping of the N2(+), B yields X, electronic transition by the kinetic step He2(+) + N2 + He yields N2+(B 2 Sigma sub u) + 3He. With proper preionization, the AEA laser has been operated at a PRF of 1 to 30 Hz in an avalanche mode at 100 to 200 A/sq. cm. and E/p of 5 v/cm/torr. At pressures from 1 to 8 atm an essentially uniform, 30 cu cm volume containing a high concentration of He2(+) has been produced. Resulting laser output pumped by the charge transfer reaction has exceeded 1MW peak power at 427.8 nm in a 4 nsec pulse. Efficiency with respect to the electrical power flowing through the laser tube has exceeded 2% and output pulse energies have exceeded 1% of the input pulse of energy dissipated in the laser tube. Author (GRA)

N78-19490# Raytheon Co., Waltham, Mass. Research Div.
CHEMICALLY VAPOR DEPOSITED SEMI-CONDUCTORS FOR LASER AND INFRARED WINDOW APPLICATIONS Final Technical Report, 15 May 1975 - 15 Nov. 1976
A. Swanson, P. Miles, and J. Pappis Jul. 1977 70 p refs
(Contract F33615-75-C-5223; ARPA Order 2421; AF Proj. 2421)
(AD-A048848; S-2146; AFML-TR-77-34) Avail: NTIS HC A04/MF A01 CSCL 20/6

The second part of this program has demonstrated the feasibility of depositing a microcrystalline form of gallium phosphide by a chemical vapor deposition process. Although close to theoretical transmittance was achieved between 5 and 12 micrometers, the material still contains residual pores that cause unacceptable scatter at visible wavelengths. Techniques were also developed to bond thin layers of this material to zinc selenide to form a composite window that withstands the mechanical abrasion of rain and particulate impacts better than other materials that are currently available. Further work is needed before an optimum bonding glass or mechanical attachment technique is developed. The first part of the program summarizes additional work performed on the chemical vapor deposition of cadmium telluride. In spite of the wider range of process conditions investigated with the elemental process, residual porosity reduces the transmittance to an unacceptable level. A chemical vapor deposition process that uses hydrogen telluride gas is apparently required to deposit laser quality material. The use of this gas will require, however, that improved forming and handling techniques be developed. Author (GRA)

N78-19491# Naval Research Lab., Washington, D. C. Optical Sciences Div.
TECHNIQUE FOR CALIBRATING HIGH ENERGY LASER CALORIMETERS Final Report
F. R. Fluhr, R. Bernard Brown, and George L. Hall 11 Oct. 1977 26 p refs
(AD-A049059; AD-E000053; NRL-8152) Avail: NTIS HC A03/MF A01 CSCL 14/2

The technique uses high-power electric lamps to inject radiant energy into the calorimeter. With this technique, an NRL ball calorimeter was calibrated using 6 lamps emitting approximately 40 kW of power. Calorimeter constants are derived from measurements of the power to the lamps and the time duration. Factors affecting accuracy are described and accuracy of the technique is evaluated. Equations of predicted response are derived, and predicted values of response are compared to measured values. Methods used to minimize ambient temperature drift and to check calibration accuracy are described.
Author (GRA)

N78-19492# Rockwell International Corp., Anaheim, Calif. Autonetics Group.
BATCH PROCESSING TECHNIQUES FOR MICROBALLOON FUSION TARGETS
W. L. Bongianni, S. M. Butler (Los Alamos Scientific Lab., N. Mex.), and J. R. Miller (Los Alamos Scientific Lab., N. Mex.) 26 Sep. 1977 7 p refs
(AD-A048807; X77-951/501) Avail: NTIS HC A02/MF A01 CSCL 11/2

Batch selection processes for laser fusion targets have been successfully developed, but the final stage of all such processes requires X-ray radiography and/or optical measurement and the judgment of a human operator. This paper considers the use of a surface acoustic wave to select and characterize glass microballoons on the basis of their mechanical response to the acoustic displacement field. Such a separator would operate in a continuous, fully automatic fashion with a consequent reduction in the cost and man-hours involved in pellet production.
Author (GRA)

N78-19493# Rockwell International Corp., Anaheim, Calif. Electronic Devices Div.
FABRICATION OF THIN FILM MAGNETIC GARNET STRUCTURES FOR INTRA-CAVITY LASER APPLICATIONS
E. C. Whitcomb and R. D. Henry 3 Nov. 1977 5 p refs Presented at the 23rd Conf. on Magnetism and Magnetic Mater., Minneapolis, 8-11 Nov. 1977
(AD-A048804; X77-971/501) Avail: NTIS HC A02/MF A01 CSCL 20/3

Garnet compositions similar to those used for bubble domain materials have been used to fabricate ferrimagnetic nonreciprocal devices for ring laser gyro biasing at 1.152 micrometers. Such devices are used inside an active laser cavity, therefore precise control of the optical and physical thickness of the films is required. Two concepts of Faraday elements have been demonstrated and new material and fabrication techniques have been developed to implement. Operating Faraday elements with 0.5 percent insertion loss have been produced. Author (GRA)

N78-19494# Naval Research Lab., Washington, D. C.
HARMONIC GENERATION IN Nd LASER-PRODUCED PLASMAS Interim Report
E. A. McLean, J. A. Stamper, B. H. Ripin, H. R. Griem, and J. A. McMahon Oct. 1977 14 p refs
(AD-A049152; AD-E000057; NRL-MR-3626) Avail: NTIS HC A02/MF A01 CSCL 20/5

The fundamental and second through fifth harmonic spectral lines have been observed from the plasma produced when a 75-psec Nd:glass (approx. 10 to the 16th power w/sq.cm.) is focused onto a thick, planar polystyrene target. Both line profiles and relative intensities of these harmonics are given.
Author (GRA)

N78-19495# Naval Research Lab., Washington, D. C.
THE NRL ONE KILOJOULE CO SUB 2 LASER
R. E. Pechacek, J. R. Greig, M. Raleigh, and S. R. Rod Sep. 1977 33 p refs
(AD-A049116; AD-E000030; NRL-MR-3602) Avail: NTIS HC A03/MF A01 CSCL 20/5

This report describes an Ultra-Violet preionized, CO2 laser head developed at NRL for use in plasma production experiments. A 1000 Joule CO2 laser, consisting of four of these heads is

to be used with a 100 J ND-glass laser to produce a large, moderately warm plasma (N = 3 x 10 to the 19th power ions, T approx 50 eV), which is to be studied in a variety of magnetic field geometries. The 3.5 liter TEA CO2 laser when connected as an oscillator followed by three amplifiers, produces one Kilojoule pulses of 10.6 micrometer radiation. The pulses consist of 70 Nsec, FWHM, initial spike followed by a 1.0 microsecond tail. The spike contains 30% of the laser pulse energy and it attains a peak power of 4.3 GW corresponding to a gas mixture of 1:1:8 (CO2:N:He). The firing rate is every 6.5 minutes. The area of the beam is 300 sq cm. The divergence of the laser beam is about 1.2 mrad, about 20 times larger than the diffraction limit. Author (GRA)

N78-19496# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

KINETICS AND WAVE LENGTH DEPENDENCE OF THE PHOTOLYTIC DEGRADATION OF KITON RED-S LASER DYE M.S. Thesis

Kevin Obrien Dec. 1977 61 p refs
(AD-A048969; AFIT/GEP/AA/77D-2) Avail: NTIS HC A04/MF A01 CSCL 20/5

The laser dye Kiton Red-S in ethanol was degraded using continuous radiation and pulsed radiation from the flash lamp of a dye laser. Data from infrared spectrograms was used to construct plots of the concentration of Kiton Red-S versus the time of exposure. From these plots the rate equation was determined. The effect on the rate of reaction of different oxygen concentrations was observed. Qualitative information from the infrared spectra was used to identify photo products. The fluorescence and power were monitored during the pulsed laser experiment to determine the primary effect of the photo products. The reaction was found to be zero th order in Kiton Red-S and the presence of oxygen accelerates the reaction. The products were found to be esters and carboxylic acids. The effect of the products on the laser was to absorb the pump radiation. Author (GRA)

N78-19497# Naval Research Lab., Washington, D. C.

LIGHT ABSORPTION BY ION ACOUSTIC TURBULENCE IN LASER-PRODUCED PLASMAS Interim Report

Wallace M. Manheimer and Denis G. Colombant Oct. 1977 34 p refs
(AD-A049222; AD-E000090; NRL-MR-3582) Avail: NTIS HC A03/MF A01 CSCL 20/5

A review of experiments on light absorption by laser-produced plasmas is presented and the need for another efficient absorption mechanism besides resonant absorption is clearly demonstrated. Laser light absorption by ion acoustic fluctuations is proposed as the missing absorption mechanism. Calculations of this absorption mechanism in a magnetized plasma are then presented. Author (GRA)

N78-19498# Aerospace Corp., El Segundo, Calif. Ivan A. Getting Labs.

THE O2(1 DELTA)-I ATOM ENERGY TRANSFER STUDIES: CW INVERSION ON 1.315-MICROMETER I-ATOM TRANSITION Interim Report

Raymond F. Heidner, III, John G. Coffer, and Carrol E. Gardner 15 Dec. 1977 87 p refs
(Contract F04701-77-C-0078)
(AD-A049028; TR-0078(3610)-1; SAMSO-TR-77-215) Avail: NTIS HC A05/MF A01 CSCL 20/5

Low-temperature ozone photolysis (LTOP) has been developed as a CW source of O2(a 1 Delta g). This method yielded large O2(1 Delta)/O2(3 Sigma) ratios in a chemically clean system. Iodine was injected into a flowing stream of the LTOP products, and the fast energy-transfer process between O2(1 Delta) and I(2P(3/2) created a population inversion,(I(2P(1/2))/(I(2P(3/2))) = or > 0.5, on the I-atom laser transition at 1.315 micrometers. The development of quantitative diagnostic techniques for the O2-I2 system and their application to both electrical discharge and LTOP generation of O2(a 1 Delta g) are described in this report. Emphasis is on the scaling required to produce a CW I-atom laser based on this latter experimental method. Author (GRA)

N78-19499# Oak Ridge National Lab., Tenn. Health Physics Div.

TWO-STATE AND TWO-STATE PLUS CONTINUUM PROBLEMS ASSOCIATED WITH THE INTERACTION OF INTENSE LASER PULSES WITH ATOMS Ph.D. Thesis - Kentucky Univ.

C. W. Choi and M. G. Payne Feb. 1977 103 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5754) Avail: NTIS HC A06/MF A01

Two mathematical models were utilized (one a form of adiabatic approximation, and the other closely related to the Zener method from collision theory) in order to calculate the probability of three-photon ionization when strong counter propagating pulses are tuned very near a two-photon resonant state. The line shape of the ionization probability is also quite unusual in this problem. A sharp onset in the ionization probability occurs as the lasers are tuned through the exact unperturbed two-photon resonance. Under proper conditions, the change can be from a very small value to one near unity. It occurs in a very small frequency range determined by the larger of the residual Doppler effect and the reciprocal duration of the pulse. The same mathematical methods have been used to calculate line shapes for the two-photon excitation of fluorescence when the atoms see a pulsed field due to their time of passage across a tightly focused CW laser beam. ERA

N78-19500# Illinois Univ., Urbana. Fusion Studies Lab.

DIRECT NUCLEAR PUMPED LASER APPROACHING FEEDBACK LASER FUSION NEEDS

M. A. Prelas, J. H. Anderson, F. B. Boody, and G. H. Miley 1977 7 p refs
(Contract EY-76-S-02-2007)
(COO-2007-87; Conf-771109-1) Avail: NTIS HC A02/MF A01

A direct nuclear pumped laser in which the lasing output is delayed for relatively long times (milliseconds) with respect to nuclear excitation is described. The laser operates at 1.45 microns in gas mixtures of He-CO and He-CO2. The nuclear pumping process is also described. Author (ERA)

N78-19501# California Univ., Livermore. Lawrence Livermore Lab.

TUNABLE LASERS IN ISOTOPE SEPARATION: A COLORFUL VIEW OF A DYE CHEMIST

Peter R. Hammond 1 Jul. 1977 18 p Presented at Workshop on Laser-Induced Chem., Seattle, 21-23 Aug. 1977 Revised
(UCRL-78934-Rev-1; Conf-770834-1) Avail: NTIS HC A02/MF A01

Some of the problems to be encountered in the possible large scale use of dye lasers in an isotope separation plant are discussed. The effect of laser dye deterioration on performance is examined algebraically in terms of disappearance of dye molecules and the appearance of a new, single chemical product having absorption in the fluorescence band for a single pass through a transversely pumped amplifier. Loss of output, defined as quantum yield of laser deterioration, is related to the true quantum yield of molecular destruction of the dye, and other known parameters. 6-Diethylamino 3-keto fluoran, an example of an oxygen tricyclic merocyanine, is described. The techniques for measurement and the excited state absorption cross sections are reported for the dyes rhodamine 6G fluoroborate in alcohol, rhodamine B basic solution in trifluoroethanol and kiton red S in trifluoroethanol. ERA

N78-19502# California Univ., Livermore. Lawrence Livermore Lab.

THEORETICAL INTERPRETATION OF ANGLE- AND POLARIZATION-DEPENDENT LASER LIGHT ABSORPTION MEASUREMENTS

J. J. Thomson, W. L. Kruer, A. B. Langdon, C. E. Max, and W. C. Mead 18 Jul. 1977 11 p refs Presented at 7th Ann. Symp. on the Anomalous Absorption of Intense High Frequency Waves, Ann Arbor, Mich., 18-20 May 1977 Revised
(Contract W-7405-eng-48)
(UCRL-79628-Rev-1; Conf-770538-2) Avail: NTIS HC A02/MF A01

It was shown that recently published observations of angle and polarization dependent absorption of intense laser light were

consistent with computer simulations of resonance absorption in a steepened plasma profile, with the additional assumption of a modestly rippled critical surface. About 10 percent absorption seems to be due to mechanisms not addressed in the simulations. ERA

N78-19503# Stanford Research Inst., Menlo Park, Calif.
RESEARCH STUDIES ON SHORT OPTICAL PULSE GENERATION FOR THE LASER FUSION PROGRAM Final Report, 11 Jan. 1976 - 11 Mar. 1977
D. J. Kuizenga 30 Mar. 1977 23 p refs
(Contract EY-76-C-03-0115-104)
(UCRL-13746) Avail: NTIS HC A02/MF A01

The single pulse energy that can be expected from a Nd:YAG laser was calculated. The factors limiting the pulse energy are discussed. It was shown that single pulse energies in the range of 0.1 to 1 mJ can reasonably be expected from this type of laser, with Nd:YAG as the active medium. ERA

N78-19504# California Univ., Livermore. Lawrence Livermore Lab.
SHIVA LASER: NEARING COMPLETION
J. A. Glaze and R. O. Godwin 12 May 1977 11 p refs Presented at SPIE X-ray Imaging Symp., Reston, Virginia, 20 Apr. 1977
(Contract W-7405-eng-48)
(UCRL-79285; Conf-770434-7) Avail: NTIS HC A02/MF A01

This laser will be operating in fall 1977 and will produce over 20 terawatts of focusable power in a subnanosecond pulse. Fusion experiments will begin early in 1978. It is anticipated that thermonuclear energy release equal to one percent that of the incident light energy will be achieved with sub-millimeter deuterium-tritium targets. From other experiments densities in excess of a thousand times that of liquid are also expected.ERA

N78-19505# California Univ., Livermore. Lawrence Livermore Lab.
OPTICAL ENGINEERING PROBLEMS ASSOCIATED WITH CONSTRUCTION OF THE SHIVA LASER FUSION FACILITY
R. O. Godwin, E. S. Bliss, J. A. Glaze, W. C. ONeal, H. G. Patton, M. A. Summers, and E. P. Wallerstein 24 Aug. 1977 6 p Presented at Intern. Optical Computing Conf., San Diego, Calif., 25 Aug. 1977
(Contract W-7405-eng-48)
(UCRL-80004; Conf-770844-5) Avail: NTIS HC A02/MF A01

The Shiva laser system is part of a new 20 terawatt laser facility. The system contains more than $5,000,000 worth of optics. This paper discusses the various optical components, typical component quantities and specification, and the problem of laser damage to components. ERA

N78-19506# Los Alamos Scientific Lab., N. Mex.
ALIGNMENT SYSTEM FOR LARGE HIGH-POWER CO2 LASER FUSION SYSTEMS
M. D. Bausman, I. Liberman, J. P. Manning, and S. Singer 1977 11 p Presented at 21st Ann. Tech. Symp. of the Soc. of Photo-Optical Instrumentation, San Diego, Calif., 22 Aug. 1977
(Contract W-7405-eng-36)
(LA-UR-77-1923; Conf-770868-1) Avail: NTIS HC A02/MF A01

The alignment of a pulsed CO2 laser fusion systems involves control system which insure that the centers of beams follow a prescribed path to within 1 mm, that the pointing of the beams is correct to approximately 20 microradians, and that the focal spot at the location of the experiment fusion target be placed to accuracies of 10 to 20 micrometers laterally and approximately 50 micrometers axially. These alignments are investigated through by a variety of sensing techniques. These techniques include thermal pinholes and quadrant detectors, Seebeck effect silicon detectors, and imaging autocollimating Hartmann test procedures employing IR vidicon systems. ERA

N78-19507# California Univ., Livermore. Lawrence Livermore Lab.
COMPUTER SIMULATION OF RECENT LASER DRIVEN IMPLOSIONS OF GLASS MICROSHELLS
A. R. Thiessen and J. T. Larsen 22 Oct. 1976 18 p refs Presented at the Plasma Phys. Meeting of the Am. Phys. Soc., San Francisco, 15 Nov. 1976
(Contract W-7405-eng-48)
(UCRL-78488; Conf-761108-32) Avail: NTIS HC A02/MF A01

Experiments were conducted on glass microshells filled with equimolar DT gas. A variety of microshell dimensions and laser pulse widths were used with the best results producing in excess of 10 to the 8th power fusion reactions. Numerical simulation of selected experiments using the lasnex computer code confirm the measured performance. Peak DT ion temperatures of about 5 keV and densities of .2 gm/cu cm are calculated and are in agreement with that from neutron time-of-flight and alpha particle spectral measurements together with X-ray diagnostics. Laser light absorption is about 20% efficient. General characteristics of exploding pusher targets are discussed. ERA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N78-19508 Connecticut Univ., Storrs.
A NON-LINEAR FREE-PISTON DYNAMIC VIBRATION ABSORBER Ph.D. Thesis
Harold McCabe Miller 1977 174 p
Avail: Univ. Microfilms Order No. 7731201

The past history of linear and nonlinear dynamic vibration absorber investigations is reviewed. A design of a dynamically tunable vibration absorber which suspends the absorber mass on two opposing air springs is described. Design parameters are discussed, and a prototype absorber, which successfully attenuated 87% of the acceleration of the main mass at resonance, is described. Analysis of the dynamics of the highly non-linear system is undertaken using an extension of the classical Reversion Method of Non-linear Analysis. This method has been extended for multi-degree-freedom systems. Stability analysis and design parameters are examined by a Frequency Domain solution based upon the extended Reversion Method. The simplification of such a solution, is shown. Dissert. Abstr.

N78-19509*# Bendix Corp., Teterboro, N. J. Gyroscopic Devices Lab.
ALTERNATE BEARING DESIGN FABRICATION AND TEST PROGRAM, EXHIBIT B Final Report
20 Feb. 1978 102 p
(Contract NAS8-31236)
(NASA-CR-150582) Avail: NTIS HC A06/MF A01 CSCL 13I

A 50 ft-lb-sec (FPS) reaction wheel was modified with an ironless armature brushless dc motor and a magnetic bearing suspension. The purpose was to demonstrate the performance of an alternate bearing concept, i.e., a magnetic bearing suspension, which could be used in Skylab type CMG's to meet the attitude control requirements of long term space stations. A magnetic suspension was built, installed and tested in the 50 FPS reaction wheel. A secondary effort included the build and test of a compatible reaction wheel motor. Performance characteristics of both are presented and discussed. Author

N78-19510*# National Aeronautics and Space Administration, Washington, D. C.
JERKY LOADS ON SURFACE-HARDENED GEARS
H. Rettig and X. Wirth Mar. 1978 22 p refs Transl. into ENGLISH from Antriebstechnik (West Germany), v. 15, no. 9, Sep. 1976 p 477-482 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(NASA-TM-75248) Avail: NTIS HC A02/MF A01 CSCL 13I

Damage occurs again and again in practice in the form of transmissions with surface hardened gears which break after a very long operating time (explained by seldom occurring jerky loads). Gear drives are frequently exposed to jerky stresses which are greater than their fatigue limit. These stresses are considered in gear calculations, first, by shock factors when the transmission is to be designed as high endurance with regard to overloads

and, second, in the form of operating ratios when the design is to be time enduring with regard to overloads. The size of the operating ratio depends not only on torque characteristics, drive and processing machine, but also on the material and heat treatment. Author

N78-19511* National Aeronautics and Space Administration, Washington, D. C.
THE DESIGN OF REACTIVE SHIELDED MAGNET CLUTCHES
S. M. Gertsov Mar. 1978 10 p refs Transl. into ENGLISH from Elektrotekhnika (USSR), no. 9, Sep. 1968 p 10-12 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75252) Copyright. Avail: NTIS HC A02/MF A01 CSCL 13I

The design of reactive shielded magnet clutches is considered along with their schematics, design formulas and characteristics of clutches in general. The design method suggested makes it possible to reduce calculation errors to 10%. Author

N78-19512*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION AND WEAR BEHAVIOR OF SINGLE-CRYSTAL SILICON CARBIDE IN SLIDING CONTACT WITH VARIOUS METALS
Kazuhisa Miyoshi and Donald H. Buckley 1978 28 p refs Presented at Ann. Meeting of Am. Soc. of Lubrication Engineers, Dearborn, Mich., 17-20 Apr. 1978
(NASA-TM-73782; E-9337) Avail: NTIS HC A03/MF A01 CSCL 11D

Sliding friction experiments were conducted with single-crystal silicon carbide in contact with various metals. Results indicate the coefficient of friction is related to the relative chemical activity of the metals. The more active the metal, the higher the coefficient of friction. All the metals examined transferred to silicon carbide. The chemical activity of the metal and its shear modulus may play important roles in metal transfer, the form of the wear debris and the surface roughness of the metal wear scar. The more active the metal, and the less resistance to shear, the greater the transfer to silicon carbide and the rougher the wear scar on the surface of the metal. Hexagon shaped cracking and fracturing formed by cleavage of both prismatic and basal planes is observed on the silicon carbide surface. Author

N78-19513*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELF-ACTING SHAFT SEALS
Lawrence P. Ludwig 1978 36 p refs Presented at AGARD Power, Energies, and Propulsion Panel Meeting on Seal Technol. in Gas Turbine Engines, London, 6-7 Apr. 1978
(NASA-TM-73856) Avail: NTIS HC A03/MF A01 CSCL 11A

Self-acting seals are described in detail. The mathematical models for obtaining a seal force balance and the equilibrium operating film thickness are outlined. Particular attention is given to primary ring response (seal vibration) to rotating seat face runout. This response analysis reveals three different vibration models with secondary seal friction being an important parameter. Leakage flow inlet pressure drop and affects of axisymmetric sealing face deformations are discussed. Experimental data on self-acting face seals operating under simulated gas turbine conditions are given. Also a spiral groove seal design operated to 244 m/sec (800 ft/sec) is described. Author

N78-19514# National Aerospace Lab., Tokyo (Japan).
STUDY ON FRICTION AND WEAR PERFORMANCE OF ION-PLATED GOLD AND SILVER FILMS
Yukio Miyakawa, Makoto Nishimura, Masataka Nosaka, and Yuzo Miyawaki Jul. 1977 105 p refs In JAPANESE; ENGLISH summary
(NAL-TR-507) Avail: NTIS HC A06/MF A01

The sliding friction properties of gold and silver films deposited by ion plating, with varying depositing conditions, were examined under various conditions and compared with those of vacuum-evaporated and sputtered films. The ion plating apparatus used was basically a diode system consisting of two electrodes. Pin-on-disk friction testers were used in the sliding tests. Author

N78-19515*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHOCK ISOLATOR FOR OPERATING A DIODE LASER AND CLOSED-CYCLE REFRIGERATOR Patent Application
Donald E. Jennings, inventor (to NASA) (NAS-NRC) Filed 24 Feb. 1978 14 p Sponsored by NASA
(NASA-Case-GSC-12297-1; US-Patent-Appl-SN-880838) Avail: NTIS HC A02/MF A01 CSCL 13E

A diode laser mounted within a helium refrigerator is mounted using a braided copper ground strap which provides good impact shock isolation from the refrigerator cold-tip while also providing a good thermal link to the cold-tip. The diode mount also contains a rigid stand-off assembly consisting of alternate sections of nylon and copper which serve as cold stations to improve thermal isolation from the vacuum housing mounting structure. Included in the mount is a Pb-In alloy wafer inserted between the cold-tip and the diode to damp temperature fluctuations occurring at the cold-tip. NASA

N78-19516# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
INVESTIGATION OF SEPARATION-LUBRICATION SUBSTANCES FOR USE IN ISOTHERMAL FORGING Final Report, 16 Dec. 1974 - 1 Jul. 1976
W. D. Spiegelberg Apr. 1977 76 p refs
(Contract F33615-74-C-5059; AF Proj. 7351)
(AD-A048588; AFML-TR-77-86) Avail: NTIS HC A05/MF A01 CSCL 11/6

A successful interface separation-lubrication substance for titanium alloy isothermal forging must simultaneously satisfy a number of demanding requirements including: (1) elevated temperature stability in a preheating environment; (2) complete chemical compatibility with workpiece alloys and dies; (3) freedom from die accumulation tendencies; (4) minimal adhesion to the hot dies after forging; and (5) excellent friction reducing properties. Evaluation techniques for these factors (except for friction reduction) were developed and applied to a series of separation-lubrication compositions representing both current state-of-technology materials and advanced formulations. Other factors such as ease of application and fusion behavior were determined. Several classes of advanced compositions were evaluated at specific temperature intervals from 1300F to 1800F. These systems included both workpiece precoat and die applied coatings. Die materials represented IN-100, TRW VIA Mod R and silicon nitride; preheat time ranged from one-half to four hours; and titanium alloys included both the alpha-beta Ti-6Al-4V and the beta stabilized 'Beta C'. GRA

N78-19517# Honeywell, Inc., Hopkins, Minn. Defense Systems Div.
HYDRAULIC CONSTANT RECOIL PROGRAM Final Report, 28 Jun. 1974 - 30 Apr. 1977
Robert Gartner 18 Nov. 1977 125 p
(Contract DAAA09-74-C-2077)
(AD-A049313; HONEYWELL-47212) Avail: NTIS HC A06/MF A01 CSCL 13/7

The design, development and testing of a test prototype hydraulic servo recoil system that reduces the recoil forces of the 20mm M197 gatling gun to near-constant levels is described. The system concept, system implementation and engineering, preflight and flight test on board an AH-1G helicopter are summarized. Preliminary conclusions are that the vibrations in the helicopter resulting from gun firing are virtually eliminated. Author (GRA)

N78-19518# TRW, Inc., Cleveland, Ohio. Advanced Energy Systems Div.
INTERFACE SEPARATION-LUBRICATION SUBSTANCES FOR ISOTHERMAL FORGING AT 1300 F TO 1500 F Final Report, 9 Jan. 1976 - 15 Feb. 1977
W. D. Spiegelberg Wright-Patterson AFB, Ohio AFML Apr. 1977 51 p refs
(Contract F33615-74-C-5059; AF Proj. 7351)
(AD-A049201; AFML-TR-77-8721) Avail: NTIS HC A04/MF A01 CSCL 13/8

A program to develop and formulate separation-lubrication compositions for isothermal forging of beta titanium alloys in the temperature range from 1300F to 1500F was successfully

completed. Several hundred compositions were chosen at the start of the program, mostly of the vitreous-phase-particulate type, containing boundary film additives or stable semi-abrasives. The field was narrowed to 28 low friction (LFC) types, 12 controlled friction (CFC) types and 8 molten salt (MSC) types. These were further evaluated through quantitative measurement of their application, fusion, stability, densification, accumulation and adhesion characteristics. Optimum combinations of these factors were selected through a simplified multifactor desirability analysis and eight final compositions were selected for further evaluation of their friction reducing properties through ring compression forging at the Westinghouse hot die isothermal forging facility at Wright-Patterson Air Force Base. These compositions included three of the LFC type, one CFC type and one molten salt type for service at the low end of the temperature range (near 1350F) on ferrous alloy dies, and three of the LFC type for service on nickel alloy dies at the high end of the thermal range (near 1500F). Author (GRA)

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N78-19519*# National Aeronautics and Space Administration, Washington, D. C.

NON-DESTRUCTIVE ULTRASONIC MEASUREMENTS OF CASE DEPTH

C. Flambard and A. Lambert Feb. 1978 13 p refs Transl. into ENGLISH of conf. paper from Inst. de Soudure, Paris, 1976 Presented at 8th World Conf. on Nondestructive Testing, Cannes, France, 6-11 Sep. 1976 Original language document was announced as A77-30117 Transl. into ENGLISH by Sci. Transl. Serv., Santa Barbara, Calif.

(NASA-TM-75225; Paper-1C-1) Avail: NTIS HC A02/MF A01 CSCL 14D

Two ultrasonic methods for nondestructive measurements of the depth of a case-hardened layer in steel are described. One method involves analysis of ultrasonic waves diffused back from the bulk of the workpiece. The other method involves finding the speed of propagation of ultrasonic waves launched on the surface of the work. Procedures followed in the two methods for measuring case depth are described. Author

N78-19520# Cornell Univ., Ithaca, N. Y.

THE ASYMPTOTIC DISTRIBUTION FOR THE TIME TO FAILURE OF A FIBER BUNDLE Technical Report, 1 May 1976 - 30 Jun. 1977

S. Leigh Phoenix Aug. 1977 63 p refs

(Contracts N00014-76-C-0790; EY-76-S-02-4027)

(AD-A049053) Avail: NTIS HC A04/MF A01 CSCL 11/5

A model is developed for the failure time of a bundle of fibers subjected to a constant load. At any time, all surviving fibers share the bundle load equally while all failed fibers support no load. The bundle may collapse immediately or fibers may fail randomly in time, possibly more than one at a time. The failure time of the bundle is the failure time of the last surviving fiber. For a single fiber, the c. d. f. for the failure time is given as a specific functional of an arbitrary load history. The model is developed using a quantile process approach. In the most important case the failure time of the bundle is shown to be asymptotically normal with known parameters. The bundle failure model has both the features of static strength and of fatigue failure of earlier analyses, and thus is more realistic than earlier models. Author (GRA)

N78-19521# Missouri Univ., Rolla. Dept. of Engineering Management.

A STUDY OF FAILURE MODE AND EFFECT ANALYSIS AND ITS ROLE IN AIR FORCE PROGRAM MANAGEMENT M.S. Thesis

Frederick Charles Potts Dec. 1977 94 p refs Sponsored in part by USAF

(AD-A048877) Avail: NTIS HC A05/MF A01 CSCL 14/4

Failure Mode and Effect Analysis (FMEA) is a systematic approach which evaluates a system with respect to its most possible failures. This is accomplished by first making the basic assumption that the system has failed and then hypothesizing specific failure modes, failure causes and failure effects. Also included is a determination of some measure of failure probability and the assignment of a criticality classification. The study examines this process through the formulation of a FMEA on a hypothetical system. The way in which FMEA is currently employed in Air Force defense system procurements is reviewed and the potential benefits of the expanded utilization are explored. The study concludes that the lack of understanding of the basic concepts and the reliability oriented use of FMEA precludes much of its potential benefit to the Air Force Program Manager. Certain benefits are emphasized if the recommended changes to the philosophy surrounding the FMEA process should be adopted. Author (GRA)

N78-19522# National Materials Advisory Board, Washington, D. C.

ECONOMIC AND MANAGEMENT ASPECTS OF NONDESTRUCTIVE TESTING, EVALUATION, AND INSPECTION IN AEROSPACE MANUFACTURING Final Report

1977 144 p refs

(Contract MDA903-74-C-0167)

(AD-A049339; NMAB-337) Avail: NTIS HC A07/MF A01 CSCL 14/2

This report reviews the roles of nondestructive testing, evaluation, and inspection as they influence the manufacturing and operational costs of aerospace systems. It is based on a study of various aspects of quality assurance, program management, process control, implementation of advanced technology, and specifications to identify factors that might influence costs. One major conclusion is that nondestructive testing (NDT) represents a small percentage of the overall costs of an aerospace system and that improvements in NDT evaluation procedures, through use of available technology, could lower costs of manufacture and reduce operational and maintenance costs. Several steps are recommended for reducing costs of NDT and increasing the overall effectiveness of the money that is spent to guarantee the reliability of aerospace systems. These recommendations include the establishment of a Department of Defense (DoD) Executive Committee on NDT to act as a steering body to guide and direct activities that will make more effective use of available technology and procedures. Other recommendations and suggestions relate to program management, the potential use of current technology, and procurement specifications. Author (GRA)

N78-19523# Bendix Corp., Kansas City, Mo.

IDENTIFICATION OF AN ELECTRO-MECHANICAL ASSEMBLY CONTAMINATION PROBLEM

J. L. Jackson Mar. 1977 21 p refs

(Contract EY-76-C-04-0613)

(BDX-613-1625-Rev) Avail: NTIS HC A02/MF A01

Measurements of organic residues were made and the organic contamination was studied for its potential contribution in causing excessive electrical resistance at the output switch contacts of electromechanical assembly. The contamination was characterized and the source of the organic residue found in failed units was examined. Contaminant characterization was determined using four quadrant chart analysis based on solubility parameter principles and Meseran surface analyzer data, mass spectrometer, Auger electron spectroscopy, and contact angle measurements. Potential contaminants introduced by maintenance, production, and inspection as process aids were investigated. Analysis was made on component parts and fixtures associated with the assembly. Ten contaminants considered acceptable are described and analyzed. Three were selected by analysis to be potentially major contributors to the electrical resistance problem. ERA

N78-19524# Bendix Corp., Kansas City, Mo.

MULTILAYERED PLATING THICKNESS MEASUREMENT

R. J. Russell, I. E. Donnell, and G. R. Osbourn Mar. 1977 20 p

(Contract EY-76-C-04-0613)

(BDX-613-1632-Rev) Avail: NTIS HC A02/MF A01

A nondestructive method for measuring multilayered plating thickness was developed utilizing intensity measurements made with an X-ray fluorescence spectrometer. A series of multilayered platings was fabricated, and the thickness of each was determined through the use of a link gage block interferometer. These samples were used in experiments to determine the absorption and enhancement effects that are present when an X-ray fluorescence spectrometer is used to measure the thickness of a multilayered plating. The results of the investigation indicated that enhancement corrections must be applied to X-ray measurements of gold thickness up to 20 microinches (508 nm). The effect of absorption of the rhodium K-Alpha line in the gold layer was found to have an insignificant effect on the measurement of rhodium thickness. The thickness of the rhodium underplate can be determined with an estimated uncertainty of +-10 microinches (254 nm). ERA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N78-19525 Colorado Univ., Boulder.
COUPLED DYNAMIC RESPONSE ANALYSIS OF MODIFIED STRUCTURAL BRANCHES Ph.D. Thesis
Anant Ratna Kukreti 1977 298 p
Avail: Univ. Microfilms Order No. 77-29940

The transient response characteristics of a complex structural system are used as a basis for evaluating the response of a similar system, identical to the original, except for changes in one or more of the original subsystems. The method utilizes the lumped parameter model and modal methods. The systems are considered to be in discrete form. Damping in the systems is assumed to be linearly related to the stiffness. The discrete system is divided into two basic subsystems. Each subsystem is analyzed to determine a linearly independent set of exact displacement functions for a modal analysis. The displacement field considered for the branch subsystem contains fixed constraint branch modes. A distinctive feature of the method is the use of specified sets of generalized modal displacement functions or mode shapes for each subsystem. Dissert. Abstr.

N78-19526 Washington Univ., St. Louis, Mo.
DYNAMIC AND NONLINEAR ANALYSIS OF SHELLS OF REVOLUTION Ph.D. Thesis
Prodyot Kumar Basu 1977 447 p
Avail: Univ. Microfilms Order No. 77-28338

Nonlinear strain-displacement relationships were derived for the case of thin to moderately thick shells of arbitrary shape and varying thickness starting with the strain tensor in Lagrangian coordinates for a three dimensional continuum. The derivation includes the effect of transverse shear strains. Various special cases for both plates and shells, including the axisymmetric ones, are also considered. In terms of generalized coordinates, the basic formulations of nonlinear equations of motion, based on Hamilton's principle, were derived using total Lagrangian, updated Lagrangian, and moving coordinate systems. For stability analysis, formulations of both linear and quadratic eigenvalue problems are presented. Dissert. Abstr.

N78-19527 Northwestern Univ., Evanston, Ill.
AN EXAMINATION OF EXPERIMENTAL TECHNIQUES IN X-RAY RESIDUAL STRESS ANALYSIS Ph.D. Thesis
Michael Royston James 1977 356 p
Avail: Univ. Microfilms Order No. 7732314

A complete computer controlled package offering maximum flexibility of operation was developed and utilized to evaluate various procedures of X ray residual stress analysis. Extensive testing of a position sensitive detector (PSD) showed that a device based on this detector can achieve a speed of analysis heretofore never obtainable in the measurement of residual stress. The PSD simultaneously collects data over the entire diffraction profile enabling the use of a multiple point parabola to define the peak without having to step scan the profile. A portable device for stress measurements based on the PSD and using a miniature air cooled X-ray tube was built to demonstrate the potential of such a system. The measuring apparatus, weighing 11 kg, could be held by one person with the electronics housed in a separate cabinet. Dissert. Abstr.

N78-19528 Northwestern Univ., Evanston, Ill.
NUMERICAL ANALYSIS OF ELASTODYNAMIC NEAR TIP STRESS FIELDS FOR STATIONARY AND PROPAGATING CRACKS Ph.D. Thesis
John Louis Glazik 1977 152 p
Avail: Univ. Microfilms Order No. 77-32307

The application of the finite element method to the computation of elastodynamic stress intensity factors was studied. Both elastodynamic stress fields generated by elastic wave diffraction by cracks, and by rapid propagation of a crack tip were investigated. The geometries were two dimensional, and both-plane and antiplane motions were considered. Dissert. Abstr.

N78-19529 Connecticut Univ., Storrs.
VIBRATION CHARACTERISTICS OF IMPERFECT CYLINDRICAL SHELLS WITH RIGIDLY FIXED ENDS Ph.D. Thesis
Charles A. Yoerkie, Jr. 1977 109 p
Avail: Univ. Microfilms Order No. 77-31239

A particular geometric imperfection in the form of a wall thickness eccentricity (e) was studied. The thickness (h) of the cyclinder was a function of circumferential position, phi, as given by h (phi) = h sub o (1-e cos phi) where h sub o is the mean thickness of the cylinder wall. Energy equations describing the cylinder motion were developed. The effect of the non-uniform wall thickness was included in both the strain energy integral and the kinetic energy derivation. Beam eigenfunctions were used as comparison functions for the commensurate fixed end conditions. Dissert. Abstr.

N78-19530 California Univ., Berkeley.
CONTINUUM MODELS FOR THE DYNAMIC ANALYSIS OF BEAMS AND BEAM-LIKE STRUCTURES Ph.D. Thesis
Omar Ibrahim Abdulkarim 1977 164 p
Avail: Univ. Microfilms Order No. 7731264

A method for obtaining approximate solutions for eigenvalue problems associated with continuum modeling of beams and beam-like structures is introduced. The method features an efficient, iterative, numerical shooting technique for simultaneous generation of the eigenvectors and estimation of the eigenvalues. It is suited for obtaining the first dozen or so frequencies and mode shapes. The continuum models proposed subscribe to varying degrees of complexity and generality for application. They are classified in two groups. The first group contains four different types of beam models that consider the mechanical properties of the structures as distributed parameters. The second group is composed of three models to idealize the behavior of multistory buildings. Various examples of applications are demonstrated. Dissert. Abstr.

N78-19531 Northwestern Univ., Evanston, Ill.
ELASTIC FIELD OF INCLUSION AND CRACK IN ANISOTROPIC MEDIA Ph.D. Thesis
Paul Chuan-Hai Cheng 1977 114 p
Avail: Univ. Microfilms Order No. 77-32286

The elastic field of an ellipsoidal inclusion inside an infinitely extended anisotropic material subjected to external load is calculated, by using the solution of eigenstrain problem. This method was first found for uniform load in isotropic material. A special case of a flat ellipsoidal crack problem is emphasized when one of the principal axes of the ellipsoidal void becomes zero. Stress concentration and interaction energy due to the presence of the inclusion (or crack) is investigated. Consequently, the critical stress of Griffith criteria is also investigated for different orientations of crack with respect to the directions of the applied load and the crystalline directions of the material. Some applications are also given to the energy consideration of precipitation in alloys. Dissert. Abstr.

N78-19532# Aeronautical Research Labs., Melbourne (Australia).
STRESS ANALYSIS OF A LUG LOADED BY A PIN
R. J. Callinan Jul. 1977 61 p refs
(ARL/Struc-Note-439; AR-000-842) Copyright. Avail: Issuing Activity

A refined stress analysis of a flexible lug loaded by a rigid pin is obtained by using the finite element method to assess the flexibility of the lug, and an iterative procedure which allows for the compatibility of lug and pin is used to determine the contact pressure distribution. A routine finite element analysis is then used to compute the stress distribution throughout the lug. This method is applicable to cases of neat, clearance or interference pins. Numerical results for neat pin fits show reasonable agreement with some test data. Author

N78-19533 Engineering Sciences Data Unit, London (England).
CURVED PANELS IN SHEAR POST-BUCKLING ANALYSIS
Oct. 1977 15 p
(ESDU-77018; ISBN-0-85679-189-X) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161

Data is given for the analysis of curved panels carrying shear loads in which the plate has buckled. A panel is defined as a thin plate, or sheet, reinforced by a system of circumferential frames and straight stiffeners. Author

N78-19534 Engineering Sciences Data Unit, London (England).
SHEAR CENTRE AND PRIMARY WARPING CONSTANT FOR LIPPED AND UNLIPPED CHANNEL AND Z-SECTIONS
Sep. 1977 10 p
(ESDU-77023; ISBN-0-85679-195-4) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $194.00

Curves and formulae for the determination of the shear center and warping constant of uniform thin walled open sections were provided. The sections covered by this item are channels with inward or outward facing lips and lipped Z-sections. As no allowance was made for shear variation across the wall thickness, the data presented relate to sections having uniform wall thickness of less than about h/15 where h is the depth of the web. Author

N78-19535*# National Aeronautics and Space Administration, Washington, D. C.
DIFFERENT ASPECTS OF LOW-CYCLE FATIGUE
C. Bathias Mar. 1978 12 p refs Transl. into ENGLISH from Mec. Materiaux Elec. (France), no. 323-324, Nov. 1976 p 3-5 Transl. by Sci. Transl. Serv., Santa Barbara, Calif. Original doc. prep. by UTC and SNIAS
(Contract NASw-2791)
(NASA-TM-75226) Avail: NTIS HC A02/MF A01 CSCL 14D

The experimental and theoretical knowledge in this field is presented. The different relations which correlate the number of cyles to rupture with strain or strain-energy are given. The application of low-cycle fatigue concepts to the crack initiation and crack propagation are briefly studied. Author

N78-19536*# National Aeronautics and Space Administration, Washington, D. C.
LOW-CYCLE FATIGUE TESTING METHODS
H. P. Lieurade Mar. 1978 34 p refs Transl. into ENGLISH from Mec. Mater. Elec. (France), no. 323-324, Nov. 1976 p 15-26 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75228) Avail: NTIS HC A03/MF A01 CSCL 14D

The good design of highly stressed mechanical components requires accurate knowledge of the service behavior of materials. The main methods for solving the problems of designers are: determination of the mechanical properties of the material after cyclic stabilization; plotting of resistance to plastic deformation curves; effect of temperature on the life on low cycle fatigue; and simulation of notched parts behavior. Author

N78-19537*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THICK SECTION ALUMINUM WELDMENTS FOR SRB STRUCTURES
E. Bayless and J. Sexton Mar. 1978 17 p
(NASA-TM-78161) Avail: NTIS HC A02/MF A01 CSCL 11F

The Space Shuttle Solid Rocket Booster (SRB) forward and aft skirts were designed with fracture control considerations used in the design data. Fracture control is based on reliance upon nondestructive evaluation (NDE) techniques to detect potentially critical flaws. In the aerospace industry, welds on aluminum in the thicknesses (0.500 to 1.375 in.) such as those encountered on the SRB skirts are normally welded from both sides to minimize distortion. This presents a problem with the potential presence of undefined areas of incomplete fusion and the inability to detect these potential flaws by NDE techniques. To eliminate the possibility of an undetectable defect, weld joint design was revised to eliminate blind root penetrations. Weld parameters and mechanical property data were developed to verify the adequacy of the new joint design. Author

N78-19538*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODE I ANALYSIS OF A FACE CRACKED PLATE SUBJECTED TO ROTATIONALLY CONSTRAINED END DISPLACEMENTS
Bernard Gross 1978 14 p refs Proposed for Presentation at the 11th Natl. Symp. on Fracture Mech., Blacksburg Va., 12-14 Jun. 1978
(NASA-TM-73777) Avail: NTIS HC A02/MF A01 CSCL 20K

Mode I stress intensity coefficients and crack mouth displacement coefficients were obtained by planar boundary collocation analysis of face cracked plates subjected to rotationally constrained end displacements. Results are presented for plates with height-to-width ratio varying from 1.0 to 5.0 and crack depth-to-plate width ratios in the range 0.1 to 0.8. Author

N78-19539*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SHEAR STRENGTH OF METAL - SiO2 CONTACTS
Stephen V. Pepper 24 Mar. 1978 6 p refs Presented at the Intern. Topical Conf. on the Physics of SiO2 and its Interfaces, Yorktown Heights, N. J., 22-24 Mar. 1978
(NASA-TM-78838) Avail: NTIS HC A02/MF A01 CSCL 20K

The strength of the bond between metals and SiO2 was studied by measuring the static coefficient of friction of metals contacting alpha-quartz in ultrahigh vacuum. It was found that copper with either chemisorbed oxygen, nitrogen, or sulphur exhibited higher contact strength on stoichiometric SiO2 than did clean copper. Since the surface density of states induced by these species on copper is similar, it appears that the strength of the interfacial bond can be related to the density of states on the metal surface. Author

N78-19540# George Washington Univ., Washington, D. C. School of Engineering and Applied Science.
DYNAMIC BUCKLING OF AXISYMMETRIC SPHERICAL CAPS WITH INITIAL IMPERFECTIONS
Robert Kao and Nicholas Perrone (Catholic Univ. of America, Washington, D. C.) Dec. 1977 41 p refs
(Contract N00014-75-C-0946)
(AD-A048844) Avail: NTIS HC A03/MF A01 CSCL 13/13

Dynamic buckling loads are obtained for axisymmetric spherical caps with initial imperfections. Two types of loading are considered, namely, step loading of infinite duration and right triangular pulse. Results show that initial imperfections do indeed have the effect of reducing the buckling capacity for both dynamic and static responses. Solutions also indicate that pulse duration has a very significant impact on the magnitude of the dynamic buckling load, and that the step loading of infinite duration is the limiting case of a triangular pulse and provides the most severe loading situation for dynamic analysis. Author (GRA)

N78-19541# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NONLINEAR COLLAPSE ANALYSIS OF CYLINDRICAL SHELLS M.S. Thesis
Norton Leslie Compton Dec. 1977 81 p refs
(AD-A048899; AFIT/GA/AA/77D-2) Avail: NTIS HC A05/MF A01 CSCL 20/11

This study was carried out to determine the effects of plasticity

and cutouts on the buckling of stiffened and nonstiffened cylindrical shells. Axial and end moment loading configurations were considered. The problem was investigated using the nonlinear and linear branches of the STAGS (Structural Analysis of General Shells) computer code. It becomes clear through this study that cutouts positioned within cylindrical shells create results that are not easily predictable using past shell experiences. The moment field in a nonlinear analysis has a much greater effect on a more flexible structure than a less flexible one. This characteristic is not present in a linear analysis due to the removal of the higher order rotation terms that effect strain. An elastic/plastic analysis appears to precipitate collapse in much the same manner as do cutouts. The collapse results obtained using a completely nonlinear plastic analysis can be closely approximated using Gerard's plasticity equation. To prevent warping of the end plane under bending two rings separated by a distance determined by the parallel axis theorem are needed to counteract the lack of rotational rigidity in the shell.

Author (GRA)

N78-19542# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

BUCKLING OF AXIALLY COMPRESSED STRINGER STIFFENED CYLINDRICAL SHELLS WITH AND WITHOUT CUTOUTS M.S. Thesis

Douglas A. Nelson Dec. 1977 160 p refs

(AD-A048967; AFIT/GAE/AA/77D-8) Avail: NTIS HC A08/MF A01 CSCL 20/11

The effects of stringer eccentricity, shell length, cutouts, and boundary conditions are studied for cylindrical shells under axial compression. Four generalized simple support and four clamped boundary conditions are considered. Buckling loads are determined through the STAGS computer code with its linear bifuration branch and smeared stringer theory. Linear prebuckling deformations and stresses as well as eccentric loading are considered in this study. STAGS incorporates an energy formulation and a finite difference technique. Results of the present theory when compared to linear classical theory show that a rigorous prebuckling analysis has a significant influence on the analysis of stringer stiffened cylinders. It was found that cutouts do not significantly change a stringer stiffened shell's sensitivity to in-plane boundary conditions but cutouts cause a substantial reduction in critical loads for externally stiffened shells. The detrimental effects of cutouts are less apparent in cylindrical shells with internal stringers. The u = 0 axial restraint is the most important factor in buckling of axially compressed stringer stiffened cylinders. Author (GRA)

N78-19543# Weidlinger Associates, Menlo Park, Calif.

EQUIPMENT-STRUCTURE INTERACTION AT HIGH FREQUENCIES Topical Report, May 1976 - Apr. 1977

J. M. Kelly and J. L. Sackman 1 Apr. 1977 75 p refs

(Contract DNA001-76-C-0110)

(AD-A049065; AD-E300036; PR-7702; DNA-4298T) Avail: NTIS HC A04/MF A01 CSCL 20/11

A series of idealized models are considered which incorporate the characteristics of an embedment media, a structure and internal equipment. The equipment has natural frequencies which are high compared with the fundamental frequency of the structure. The purpose of the analysis is to obtain exact solutions to the idealized model. These may eventually be compared with solutions obtained by standard structural dynamics techniques to improve understanding of the degree of refinement needed in modeling and to provide guidance for selecting appropriate numerical integration techniques. Certain results on the vibration of equipment have been obtained which appear to be new. These techniques are applied to a structure-equipment system using models that are representative of silo-like protective structures. Excitations simulating ground shock, air shock and shaker loading are examined. Author (GRA)

N78-19544# Teledyne Engineering Services, Waltham, Mass.

IMPROVED EVALUATION OF NOZZLE CORNER CRACKING Final Report

Lester M. Cohen, John L. McLean, George Moy, and Philip M. Besuner (Failure Analysis Associates, Palo Alto, Calif.) Mar. 1977 325 p refs

(EPRI Proj. 700; EPRI Proj. 498)

(EPRI-NP-339) Avail: NTIS HC A14/MF A01

Stress intensity factors for fifteen postulated corner flaw locations in a typical feedwater nozzle subjected to pressure and thermal stresses were provided. The effect of a residual stress caused by the weld deposited cladding was also considered. The use of these data permits more accurate fracture mechanics evaluation of nozzle corner flaws. ERA

N78-19545# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

EVALUATION OF THE EFFECTS OF BREAK NOZZLE CONFIGURATION IN THE SEMISCALE MOD-1 SYSTEM

R. G. Hanson Aug. 1977 43 p refs

(Contract EY-76-C-07-1570)

(TREE-NUREG-1118) Avail: NTIS HC A03/MF A01

The semiscale Mod-1 program utilized two different break nozzle configurations in the test system. An evaluation was made to determine the effect these break nozzle configurations have on system thermal hydraulic response during a 200 percent double ended cold leg break loss-of-coolant accident simulation. The first nozzle was a convergent-divergent nozzle and the second, an elongated constant area throat nozzle. Analysis was confined primarily to system response phenomena observed to be affected by the nozzle configuration and concentrates on the fluid response at the break and the resulting core behavior during subcooled and saturated blowdown. The evaluation shows that considerable difference in system response occurs as a result of the difference in break nozzle configuration. The elongated throat nozzle was scaled from the Loss-of-Fluid test (LOFT) nozzle geometry and since the LOFT counterpart tests were designed to provide results for the LOFT Program, the elongated throat nozzle was used in the subsequent LOFT counterpart tests. ERA

N78-19546# Oak Ridge National Lab., Tenn.

ELEVATED-TEMPERATURE BENCHMARK TESTS OF SIMPLY SUPPORTED BEAMS AND CIRCULAR PLATES SUBJECTED TO TIME-VARYING LOADINGS

J. M. Corum, M. Richardson, and J. A. Clinard 8 Aug. 1977 160 p

(Contract W-7405-eng-26)

(ORNL-5301) Avail: NTIS HC A08/MF A01

The measured elastic plastic creep responses of eight simply supported type 304 stainless steel beams and circular plates that were subjected to time varying loadings at elevated temperatures were presented. The tests were performed to provide experimental benchmark problem data suitable for assessing inelastic analysis methods and for validating computer programs. Beams and plates exhibit the essential features of inelastic structural behavior. The stress fields are largely uniaxial in beams, while multiaxial effects were introduced in plates. The specimens tested were laterally loaded at the center and subjected to either a prescribed load or a center deflection history. The specimens were machined from a common well characterized heat of material, and all the tests were performed at a temperature of 593 C (1100 F). Test results are presented in terms of the load and center deflection behaviors, which typify the overall structural behavior. Additional deflection data, as well as strain gage results and mechanical properties data for the beam and plate material, are provided. ERA

N78-19547# Sandia Labs., Albuquerque, N. Mex. Design Technology Div.

CREEP FATIGUE DAMAGE UNDER MULTIAXIAL CONDITIONS

D. W. Lobitz and R. E. Nickell 1977 17 p refs Presented at 4th Intern. Conf. on Structural Mech. in Reactor Technol., San Francisco, 15 Aug. 1977

(Contract EY-76-C-04-0789)

(SAND-77-0296C; Conf-770807-3) Avail: NTIS HC A02/MF A01

When structural components are subjected to severe cyclic loading conditions with intermittent periods of sustained loading at elevated temperature, the designer must guard against a failure mode caused by the interaction of time-dependent and time-independent deformation. This phenomena is referred to as creep-fatigue interaction. The most elementary form of interaction theory is now embodied in the ASME Boiler and Pressure Vessel Code. In recent years, a competitor for the linear damage summation theory has emerged, called strainrange partitioning.

This procedure is based upon the visualization of the cyclic strain in a uniaxial creep-fatigue test as a hysteresis loop, with the inelastic strains in the loop counter-balanced in one of two ways. The two theories are compared and contrasted in terms of ease of use, possible inconsistencies, and component life prediction. Future work to further test the damage theories is recommended. ERA

N78-19548# California Univ., Livermore. Lawrence Livermore Lab.
FUNDAMENTAL STUDY OF CRACK INITIATION AND PROPAGATION Annual Progress Report, Mar. 1976 - Mar. 1977
D. M. Norris, Jr., ed. 1 Jun. 1977 83 p refs
(Contract W-7405-eng-48)
(UCRL-52296) Avail: NTIS HC A05/MF A01

Ductile fracture in nuclear pressure vessel steel was characterized using a computer model of material damage. The model predicts crack initiation and growth and contains constants that are set by computer simulation of the following fracture tests: the simple tension test, the circumferentially notched round tension test, the blunt-notched compact tension test, and the Charpy V-notch test. The simulations provide the stress and strain states of these tests at fracture. The major goal of our characterization program is to determine the correlation between Charpy toughness and fracture toughness. ERA

N78-19549# California Univ., Livermore. Lawrence Livermore Lab.
COMPUTER SIMULATIONS OF HIGH PRESSURE SYSTEMS
M. L. Wilkins 18 Jul. 1977 16 p Presented at 6th AIRAPT Intern. High-Pressure Conf., Boulder, Colo., 25 Jul. 1977
(Contract W-7405-eng-48)
(UCRL-79591; Conf-770706-30) Avail: NTIS HC A02/MF A01

A finite difference program is described that solves problems over this range and in two and three space-dimensions and time. A series of experiments and calculations serve to establish confidence in the plasticity formulation. The program can be used to design high pressure systems where plastic flow occurs. The purpose is to identify material properties, strength and elongation, that meet the operating requirements. An objective is to be able to perform destructive testing on a computer rather than on the engineering structure. Examples of topical interest are given. ERA

N78-19550# California Univ., Livermore. Lawrence Livermore Lab.
PLANE STRAIN LARGE DEFORMATION ANALYSIS OF THIS CYLINDRICAL SHELL SUBJECT TO EXTERNAL PRESSURE
S. C. H. Lu Aug. 1977 17 p
(Contract W-7405-eng-48)
(UCID-17567) Avail: NTIS HC A02/MF A01

The analytical results of a plane strain large displacement analysis of a thin cylindrical shell subjected to nonuniform external pressure are reported. The purpose of the analysis is to determine the ultimate load capacities and hence, the design margins of safety of the shell structure for both the static and the dynamic loading conditions. The finite element method was used to solve the numerical problem. For dynamic analysis, the implicit Houbolt operator was utilized to perform the time integration. All numerical computations were accomplished using the nonlinear finite element program MARC. The analysis is one of the tasks required for the technical assistance program, Safety Margin Associated with Containment Structures Under Dynamic Loading. ERA

N78-19551# Babcock and Wilcox Co., Akron, Ohio. Nuclear Equipment Div.
STRESSES FROM PRESSURE, RADIAL, AND MOMENT LOADS IN CYLINDER-TO-CYLINDER VESSEL BY A FINITE PLATE METHOD
S. J. Brown and M. E. Fox Aug. 1977 23 p refs Presented at the 4th Intern. Conf. on Structural Mech. in Reactor Tech., San Francisco, 15 Aug. 1977
(Contract EY-76-C-15-2395)
(CONF-770807-25) Avail: NTIS HC A02/MF A01

A simple technique, the finite plate method, is presented to analyze stresses in cylinder-to-cylinder junctures. The approach uses shallow shell formulations and a three term series expansion plate formulation, which limits the range of applicability. The value of the method is its accuracy, economy, and ease in modeling a structure which falls within the range of applicability. Another appealing feature of the method is that its simplistic approach of superposition of results permits an easy extension to include additional loads not treated. For those mechanical loadings not developed, their effect can either be accounted for by the mechanisms discussed or by simple calculations. Generally, the stresses resulting from torsional or transverse shear are small compared to the loads discussed, however, these shear effects may be included. ERA

N78-19552# California Univ., Livermore. Lawrence Livermore Lab.
COMPUTER SIMULATION OF THE CHARPY V-NOTCH TOUGHNESS TEST
D. M. Norris, Jr. 15 Aug. 1977 18 p Presented at the 4th Intern. Conf. on Structural Mech. in Reactor Technol., San Francisco, 15 Aug. 1977
(Contract W-7405-eng-48)
(UCRL-79762; Conf-770807) Avail: NTIS HC A02/MF A01

The calculational models (for A-533 Grade B class 1 steel) used both a rounded and a flat tipped striker. The notch stress/strain state was found to be independent of the three-point loading type and was most strongly correlated with notch opening displacement. The dynamic stress/strain state at the time of fracture initiation was obtained by comparing the calculated deformed shape with that obtained in interrupted Charpy V-notch tests where cracking had started. The calculation was also compared with stress/strain states calculated in other geometries at failure. The distribution and partition of specimen energy was calculated and adiabatic heating and strain rate are discussed. ERA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N78-19553 Purdue Univ., Lafayette, Ind.
ANALYSIS OF SINGLE AND DOUBLE COVERAGE AIRCRAFT MULTISPECTRAL SCANNER ARRAYS FOR POSITIONAL DATA Ph.D. Thesis
Max Michael Ethridge 1977 317 p
Avail: Univ. Microfilms Order No. 77-30073

The development of an analytical model for the restitution of multiply scanned multispectral scanner (MSS) digital data arrays was investigated. A brief discussion concerning the potential mapping applications of aircraft MSS digital data was followed by a description of six geometric restitution techniques. The six techniques, which include collinearity, piecewise polynomials, weighted mean, moving averages, meshwise linear interpolation, and Gauss-Markov models, were each used to restitute four strips of actual aircraft MSS digital data. An analysis of the results obtained from considerable experimentation with the recently proposed Gauss-Markov model was also presented. The restitution results from the six techniques provide input for a statistically based analysis involving analysis of variance and Newman-Keuls techniques. By considering the results of the statistical analysis together with subjective factors, the three most suitable techniques were found. Dissert. Abstr.

N78-19554 Purdue Univ., Lafayette, Ind.
DATA COMPRESSION FOR BINARY AND MULTI-LEVEL SATELLITE IMAGERY Ph.D. Thesis
Po Hsiin Chen 1977 176 p
Avail: Univ. Microfilms Order No. 77-30067

An efficient data compression system is presented for satellite pictures and two-level/multi-level pictures derived from satellite pictures. The compression techniques utilized correlation among adjacent picture elements. Several source coding methods were investigated. Double delta coding is presented and shown to be the most efficient of those discussed. Both the predictive differential quantizing technique and double delta coding were significantly improved by applying a background skipping technique. Several classes of codes representing the derived data resulting from the source coding techniques were examined. A prefix-extension code was constructed, which required very little storage space and operated efficiently. Simulation results are presented for various coding schemes and source codes. Dissert. Abstr.

N78-19555*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT US STANDARD CATALOG, 1-31 DECEMBER 1977
Dec. 1977 70 p
(NASA-TM-79367; GSFC/LU-C/012; NTISUB/C/138-012)
Avail: NTIS HC A04/MF A01 CSCL 05B

The U.S. Standard Catalog lists U.S. imagery acquired by LANDSAT 1 and 2 which has been processed and input to the data files during the referenced month. Data, such as data acquired, cloud cover and image quality are given for each scene. The microfilm roll and frame on which the scene may be found is also given. Author

N78-19556*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT NON-US STANDARD CATALOG, 1-31 DECEMBER 1977
Dec. 1977 47 p
(NASA-TM-79365; GSFC/LN-C/012; NTISUB/C/139-012)
Avail: NTIS HC A03/MF A01 CSCL 05B

The non-U.S. Standard Catalog lists non-U.S. imagery acquired by Landsat 2 which has been processed and input to the data files during the referenced month. Data, such as date acquired, cloud cover and image quality are given for each scene. The microfilm roll and frame on which the scene may be found is also given. Author

N78-19557 Texas A&M Univ., College Station.
AN ASSOCIATIVE AND NONPARAMETRIC DIGITAL INFORMATION PROCESSING TECHNIQUE FOR APPLICATION IN REAL-TIME, ON-BOARD PATTERN RECOGNITION Ph.D. Thesis
Homayoun Malek-Shahmirzadi 1977 150 p
Avail: Univ. Microfilms Order No. 77-32175

As a feasible solution to the problem of on-board classification of the LANDSAT MSS data, the Real-time, Associative Pattern IDentification (RAPID) technique developed and described herein. The RAPID technique was formulated based on the criteria of minimizing (1) probability of misclassification, (2) computational time and (3) computational hardware. Further optimization of the classification technique was achieved by design of a special purpose digital processor which was configured around the associative information storage and retrieval concept. Performance of the RAPID technique and the effect of the independence assumption were evaluated. Dissert. Abstr.

N78-19558 Texas A&M Univ., College Station.
CONSTRAINED NONLINEAR ESTIMATION APPLIED TO EARTH RESOURCES SATELLITE DATA Ph.D. Thesis
Henry Fred Ander 1977 78 p
Avail: Univ. Microfilms Order No. 77-32138

A variate transformation model was employed to estimate the percentage of a large land segment covered by a particular crop based on spectral intensity data. The procedure was based on a transformation of a mixed distribution of crop signatures into their known marginal distributions. The parameter estimates for the transformation were obtained simultaneously with the proportion of each crop type of interest on the land segment. Monte Carlo studies were made to investigate the properties of the estimates and the effectiveness of the solution methods applied. Dissert. Abstr.

N78-19559 Kansas State Univ., Manhattan.
EVALUATING GREAT PLAINS EVAPOTRANSPIRATION USING LANDSAT AND THERMAL IMAGERY Ph.D. Thesis
James Lester Heilman 1977 115 p
Avail: Univ. Microfilms Order No. 7800814

Crop temperature was measured remotely, and a form of the energy-balance equation that used crop temperature and the diffusion resistance to heat transport r sub H in the turbulent boundary layer was evaluated. Resistances were determined from wind speed and temperature profiles. Using aerial, thermal-scanner measurements of crop temperature evapotranspiration, estimates using the resistance model differed from lysimetric measurements by -0.40 to 0.17 ly/min, primarily due to errors in scanner measurements caused by atmospheric attenuation. Results indicated that thermal-scanner measurements of crop temperature in the resistance were useful for estimating ET on a regional basis if accurate estimates of r sub H were obtained and if scanner measurements were accurately extrapolated to ground level. Dissert. Abstr.

N78-19560*# Geological Survey, Denver, Colo.
GEOLOGICAL APPLICATIONS OF THERMAL-INERTIA MAPPING FROM SATELLITE Progress Report, 1 Dec. 1977 - 28 Feb. 1978
Terry W. Offield, Principal Investigator and S. H. Miller 1 Mar. 1978 19 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(E78-10081; NASA-CR-155759) Avail: NTIS HC A02/MF A01 CSCL 08G

The author has identified the following significant results. A more efficient algorithm for calculating surface temperature was developed. This algorithm was determined to be essentially exact, and relative accuracies in determining thermal inertia of the finite difference and the linear Fourier series algorithms were approximately 5% for both. A procedure for performing geometric registration was developed.

N78-19561*# Michigan State Univ., East Lansing. Agricultural Experiment Station.
GUIDE TO AERIAL IMAGERY OF MICHIGAN
William R. Enslin and Richard Hill-Rowley, Principal Investigators Nov. 1977 212 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Grant NGL-23-004-083)
(E78-10082; NASA-CR-155760; RR-340) Avail: NTIS HC A10/MF A01 CSCL 08B

There are no author-identified significant results in this report.

N78-19562*# Bendix Corp., Ann Arbor, Mich.
LAND USE INVENTORY THROUGH MERGING OF LANDSAT (SATELLITE), AERIAL PHOTOGRAPHY AND MAP SOURCES
Robert H. Rogers, Larry E. Reed, William R. Enslin (Michigan State Univ., East Lansing), Kenneth E. Keifenheim (Michigan State Univ., East Lansing), Thomas H. Haga (GLS Region 5 Planning and Development Commission, Flint, Mich.), and Robert Karwowski (GLS Region 5 Planning and Development Commission, Flint Mich.) 2 Sep. 1977 16 p refs Presented at the Fall Meeting of the Am. Soc. of Photogrammetry and the Am. Congr. on Surveying and Mapping, Little Rock, Ark., 18-21 Oct. 1977 Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(E78-10083; NASA-CR-155761; BSR-4292) Avail: NTIS HC A02/MF A01 CSCL 08B

There are no author-identified significant results in this report.

N78-19563*# Geological Survey, Denver, Colo.
THE MIXTURE PROBLEM IN COMPUTER MAPPING OF

TERRAIN: IMPROVED TECHNIQUES FOR ESTABLISHING SPECTRAL SIGNATURES, ATMOSPHERIC PATH RADIANCE, AND TRANSMITTANCE Final Report, 1 Jul. 1972 - 10 May 1974
Harry W. Smedes, Principal Investigator, Roland L. Hulstrom (Martin Marietta Aerospace Corp., Denver, Colo.), and K. Jon Ranson (Colorado State Univ., Fort Collins) 15 Mar. 1978 66 p refs Presented at Proc. of the NASA Earth Resources Survey Symp., Houston, Tex., 8-13 Jun. 1975 Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(NASA Order S-70243-AG)
(E78-10084; NASA-CR-155762) Avail: NTIS HC A04/MF A01 CSCL 08G

There are no author-identified significant results in this report.

N78-19564*# Dartmouth Coll., Hanover, N.H.
AN INVESTIGATION OF AGRICULTURAL AND OTHER EARTH RESOURCE PARAMETERS USING LANDSAT AND OTHER REMOTE SENSING DATA. A: LANDSAT. B: REMOTE SENSING OF VOLCANIC EMISSIONS Semiannual Status Report, 1 Jul. - 31 Dec. 1977
Robert E. Huke, Vincent M. Malmstrom, Charles L. Drake, Robert C. Reynolds, Richard W. Birnie, and Richard E. Stoiber, Principal Investigators 31 Dec. 1977 43 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Grant NsG-5014)
(E78-10085; NASA-CR-155763) Avail: NTIS HC A03/MF A01 CSCL 02C

There are no author-identified significant results in this report.

N78-19565*# Michigan State Univ., East Lansing.
IMPACT ANALYSIS OF OFF-ROAD-VEHICLE USE ON VEGETATION IN THE GRAND MERE DUNE ENVIRONMENT
Ger Schultink, Principal Investigator 1977 9 p refs Presented at the 6th Biennial Workshop on Color Aerial Photography in the Plant Sci. and Related Fields, Am. Soc. of Photogrammetry, Ft. Collins, Colo., 9-11 Aug. 1977 ERTS
(Grant NGR-23-004-083)
(E78-10086; NASA-CR-155764) Avail: NTIS HC A02/MF A01 CSCL 13B

The author has identified the following significant results. A linear regression between percent nonvegetative land and the time variable was completed for the two sample areas. Sample area no. 1 showed an average vegetation loss of 1.901% per year, while the loss for sample area no. 2 amounted to 5.889% per year. Two basic reasons for the difference were assumed to play a role: the difference in access potential and the amount of already fragmented vegetation complexes in existence during the first year of the comparative analysis - 1970. Sample area no. 2 was located closer to potential access points and was more fragmented initially.

N78-19566*# Servicio Geologico de Bolivia, La Paz.
BOLIVIAN SATELLITE TECHNOLOGY PROGRAM ON ERTS NATURAL RESOURCES [PROGRAMA DEL SATELITE TECHNOLOGICO DE RECURSOS NATURALES ERTS: BOLIVIA SERVICIO GEOLOGICO DE BOLIVIA]
Carlos Brockmann H., Principal Investigator, Luis Bartoluccic C., Robert Hoffer, D. W. Levandowski, Isaac Ugarte, Rene Valenzuela R., Moises Urena E., and Reynaldo Oros Jul. 1977 168 p refs In ENGLISH and SPANISH Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(E78-10087; NASA-CR-155765; Rept-1) Avail: NTIS HC A08/MF A01 CSCL 08G

The author has identified the following significant results. Application of digital classification for mapping land use permitted the separation of units at more specific levels in less time. A correct classification of data in the computer has a positive effect on the accuracy of the final products. Land use unit comparison with types of soils as represented by the colors of the coded map showed a class relation. Soil types in relation to land cover and land use demonstrated that vegetation was a positive factor in soils classification. Groupings of image resolution elements (pixels) permit studies of land use at different levels, thereby forming parameters for the classification of soils.

N78-19567*# Fort Lewis A&M Coll., Durango, Colo.
DEVELOPMENT OF A WINTER WHEAT ADJUSTABLE CROP CALENDAR MODEL Final Report
James R. Baker, Principal Investigator 14 Feb. 1978 77 p refs EREP
(Contract NAS9-15276)
(E78-10088; NASA-CR-151644) Avail: NTIS HC A05/MF A01 CSCL 02C

The author has identified the following significant results. After parameter estimation, tests were conducted with variances from the fits, and on independent data. From these tests, it was generally concluded that exponential functions have little advantage over polynomials. Precipitation was not found to significantly affect the fits. The Robertson's triquadratic form, in general use for spring wheat, was found to show promise for winter wheat, but special techniques and care were required for its use. In most instances, equations with nonlinear effects were found to yield erratic results when utilized with daily environmental values as independent variables.

N78-19568*# Fort Lewis A&M Coll., Durango, Colo.
DEVELOPMENT OF A WINTER WHEAT ADJUSTABLE CROP CALENDAR MODEL. VOLUME 2: APPENDICES Final Report
James R. Baker, Principal Investigator 14 Feb. 1978 79 p EREP
(Contract NAS9-15276)
(E78-10089; NASA-CR-151643) Avail: NTIS HC A05/MF A01 CSCL 02C

There are no author-identified significant results in this report.

N78-19569*# National Oceanic and Atmospheric Administration, Washington, D. C.
APPLICATIONS OF HCMM DATA TO SOIL MOISTURE SNOW AND ESTUARINE CURRENT STUDIES Quarterly Report
Donald R. Wiesnet, Principal Investigator, David F. McGinnis, and Michael Matson 1 Mar. 1978 6 p Sponsored by NASA ERTS
(E78-10090; NASA-CR-155795; QR-2) Avail: NTIS HC A02/MF A01 CSCL 08H

There are no author-identified significant results in this report.

N78-19570*# Stanford Univ., Calif. Remote Sensing Lab.
GEOLOGICAL AND GEOTHERMAL DATA USE INVESTIGATIONS FOR APPLICATION EXPLORER MISSION-A: HEAT CAPACITY MAPPING MISSION Progress Report, 1 Dec. 1977 - 28 Feb. 1978
R. J. P. Lyon and A. E. Prelat, Principal Investigators 28 Feb. 1978 10 p Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Contract NAS5-24232)
(E78-10092; NASA-CR-155773) Avail: NTIS HC A02/MF A01 CSCL 08B

The author has identified the following significant results. Analysis of local areas by point-to-point registration was achieved.

N78-19571*# California Univ., Berkeley. Space Sciences Lab.
APPLICATION OF REMOTE SENSING TO SELECTED PROBLEMS WITHIN THE STATE OF CALIFORNIA Annual Progress Report
Robert N. Colwell, Andrew S. Benson, John E. Estes, and Leonard W. Bowden, Principal Investigators 20 Dec. 1977 145 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Grant NsG-7220)
(E78-10093; NASA-CR-155805; SSL-Ser-19-Issue-5) Avail: NTIS HC A07/MF A01 CSCL 08F

There are no author-identified signficant results in this report.

N78-19572*# Geological Survey, Denver, Colo.
PROPOSAL FOR A STUDY OF COMPUTER MAPPING OF TERRAIN USING MULTISPECTRAL DATA FROM ERTS-A FOR THE YELLOWSTONE NATIONAL PARK TEST SITE Final Report, 15 Jun. 1972 - 1 Nov. 1973
Harry W. Smedes, Principal Investigator, Ralph R. Root (National Park Service, Denver, Colo.), Norman E. G. Roller (Environmental Research Inst. of Michigan, Ann Arbor), and Don Despain (National Park Service, Yellowstone National Park, Wyoming) 15 Mar. 1978 33 p refs Presented at 9th Intern. Symp. of Remote Sensing of Environment, Ann Arbor, Mich., 15-19 Apr. 1974 Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(NASA Order S-70243-AG)
(E78-10094; NASA-CR-155776) Avail: NTIS HC A03/MF A01 CSCL 08B

The author has identified the following significant results. A terrain map of Yellowstone National Park showed plant community types and other classes of ground cover in what is basically a wild land. The map comprised 12 classes, six of which were mapped with accuracies of 70 to 95%. The remaining six classes had spectral reflectances that overlapped appreciably, and hence, those were mapped less accurately. Techniques were devised for quantitatively comparing the recognition map of the park with control data acquired from ground inspection and from analysis of sidelooking radar images, a thermal IR mosaic, and IR aerial photos of several scales. Quantitative analyses were made in ten 40 sq km test areas. Comparison mechanics were performed by computer with the final results displayed on line printer output. Forested areas were mapped by computer using ERTS data for less than 1/4 the cost of the conventional forest mapping technique for topographic base maps.

N78-19573*# Atomic Energy Commission, Dacca (Bangladesh).
BANGLADESH ERTS (LANDSAT) PROGRAMME: A REVIEW OF THE PROGRAMME AND A REPORT ON THE ACTIVITIES Final Report, Aug. 1972 - Nov. 1977
Anwar Hossain, Principal Investigator Nov. 1977 57 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux. Falls, S. D. ERTS
(E78-10095; NASA-CR-155777) Avail: NTIS HC A04/MF A01 CSCL 05B

There are no author-identified significant results in this report.

N78-19574*# Geological Survey, Reston, Va.
SATELLITE GEOLOGICAL AND GEOPHYSICAL REMOTE SENSING OF ICELAND Final Report, 15 Jan. 1973 - 15 Aug. 1974
Richard S. Williams, Jr., Principal Investigator 1 Jan. 1978 109 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(NASA Order S-70243-AG)
(E78-10096; NASA-CR-155787) Avail: NTIS HC A06/MF A01 CSCL 08F

The author has identified the following significant results. The ERTS imagery has sufficient resolution to map, from MSS color composites, areas of altered ground caused by high temperature geothermal activity at the Namafjall, Torfajokull, and Reykjanes geothermal areas. The major axes of the fallout pattern of tephra from the May - July 1970 volcanic eruption from Hekla Volcano can be mapped where sufficient depth of deposition was present to seriously affect the normal vegetation. Lava flows from the 1961 volcanic eruption at Askja; some of the lava flows from the 1947-48 eruption, and and all of the lava flows from the 1970 eruption at Hekla; and the areas covered by tephra and lava from the 1973 eruption on Heimaey could be delineated. Low sun angle imagery of less than 10 deg of snow covered terrain was particularly valuable in mapping structural and volcanic features concealed beneath glacial ice in the active volcanic zones of Iceland.

N78-19575*# Science Applications, Inc., La Jolla, Calif.
DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM LANDSAT DATA Final Report
M. Griggs, Principal Investigator 27 Jan. 1978 71 p refs ERTS
(Contract NAS5-20899)
(E78-10097; NASA-CR-155788; SAI-78-525-LJ) Avail: NTIS HC A04/MF A01 CSCL 04A

The author has identified the following significant results. A large set of LANDSAT 2 data, obtained at San Diego, showed excellent linear relationships, particularly for MSS 5 and MSS 6, between the radiance over the ocean and the atmospheric aerosol content. Two other data points obtained at Adrigole, Ireland, representing a different ocean and a different ground truth instrument, showed very good agreement with the San Diego data. It appeared that the technique could be used for global monitoring of the atmospheric aerosol content over the oceans. Results obtained at several inland bodies of water showed that MSS 4, MSS 5, and MSS 6 cannot be used due to the effect of water pollution generally present. However, the LANDSAT 1 results suggested that MSS 7, which operates at longer wavelengths, was not very sensitive to water pollution, and might be useful for inland measurements of aerosol content. Use of the longer wavelength would also minimize the effects of adjacent high albedo land, since atmospheric scattering was reduced at longer wavelengths.

N78-19576*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
FORECASTS OF WINTER WHEAT YIELD AND PRODUCTION USING LANDSAT DATA Final Report, May 1975 - Oct. 1977
R. F. Nalepka, Principal Investigator, J. E. Colwell, and D. P. Rice Dec. 1977 160 p refs ERTS
(Contract NAS5-22389)
(E78-10098; NASA-CR-155794; ERIM-114800-38-F) Avail: NTIS HC A08/MF A01 CSCL 02C

There are no author-identified significant results in this report.

N78-19577*# California Univ., Berkeley. Electronics Research Lab.
MICROWAVE SCATTERING PROPERTIES OF SNOW FIELDS
D. J. Angelakos Dec. 1977 6 p refs Presented at the NASA Microwave Remote Sensing Symp., Houston, Tex., 6-7 Dec. 1977
(Grant NsG-5093)
(NASA-CR-155799) Avail: NTIS HC A02/MF A01 CSCL 08L

Experimental results were presented showing backscatter dependence on frequency, angle of incidence, snow wetness, and frequency modulation. Theoretical studies were made of the inverse scattering problem yielding some preliminary results concerning the determination of the dielectric constant of the snow layer. The experimental results lead to the following conclusions: (1) snow layering affects backscatter; (2) layer response was significant up to 45 degrees of incidence; (3) wetness modifies snow layer effects; and (4) frequency modulation masks the layer response. Author

N78-19578*# California Univ., Berkeley.
COHERENT MICROWAVE BACKSCATTER OF NATURAL SNOWPACKS
W. I. Linlor (NASA Ames Res. Center), D. J. Angelakos, F. D. Clapp, and J. L. Smith (Forest Service, Berkeley, Calif.) 1977 18 p refs
(Grant NsG-5093)
(NASA-CR-155800) Avail: NTIS HC A02/MF A01 CSCL 08L

The backscatter of natural snowpacks was measured using a swept-frequency system operating from 5.8 to 8.0 GHz. Snow layering produced sequences of maxima and minima in backscatter intensity, with typical peak-to-valley ratios of 15 db. Wetness produced in the upper portion of the snowpack by solar heat input enhanced the effect of layering. The layer response persisted for incidence exhibits predominantly coherent properties. Frequency modulation of the incident signal masked the layer response

by averaging the unmodulated response over the bandwidth represented by the modulation. Further changes in backscatter were attributed to changes in wetness in the surface regions of the snowpack; for a fixed frequency of 13.5 GHz and incidence angle of 39 deg, the backscatter decreased typically 15 db between 11 A.M. and noon, and returned to approximately its initial level of overnight. Author

N78-19579*# Earth Satellite Corp., Washington, D. C.
APPLICATION OF THE ELECTRICALLY SCANNING MICROWAVE RADIOMETER (ESMR) TO CLASSIFICATION OF THE MOISTURE CONDITION OF THE GROUND Final Report, Apr. 1975 - Mar. 1977
Jack M. Meneely Mar. 1977 43 p refs
(Contract NAS5-22398)
(NASA-CR-156692; ES-1042) Avail: NTIS HC A03/MF A01 CSCL 08M

The ability of the Nimbus 5 ESMR to characterize the moisture condition of the uppermost portion of the soil was evaluated. In the absence of snow cover, ESMR-5 brightness temperatures were compared with computed upper soil zone moisture values from a soil moisture budgeting scheme. The study was conducted over the U.S. Great Plains for the late summer and early fall in 1974 and 1975. Favorable results were limited by the relatively high vegetative cover and infrequent substantial rainfalls at that time of year. Satisfactory characterization of the general moisture condition was deemed feasible in agricultural regions at times of the year when fields were nearly bare. An additional evaluation demonstrated that ESMR-6 data could delineate the active boundary of a snow pack. Author

N78-19580*# International Business Machines Corp., Gaithersburg, Md. Advanced Image Processing Development Dept.
BI-RESAMPLED DATA STUDY Final Report, Oct. 1976 - Mar. 1977
R. Benner and W. Young Mar. 1977 143 p
(Contract NAS5-23708)
(NASA-CR-156710) Avail: NTIS HC A07/MF A01 CSCL 08B

The results of an experimental study conducted to determine the geometric and radiometric effects of double resampling (bi-resampling) performed on image data in the process of performing map projection transformations are reported. Author

N78-19581*# National Aeronautics and Space Administration, Washington, D. C.
APPLICATION OF SATELLITE PICTURES TO CENSUS OPERATIONS. BOLIVIAN EXPERIENCE IN CENSUS-TAKING OF POPULATION AND RESIDENCES
Mar. 1978 14 p Transl. into ENGLISH of "Aplicaciones de las Imagines de Satelite A Operaciones Censales. Experiencia Boliviana en el Censo de Poblacion y Vivienda", Rept., Inst. Nacl. de Estadistica, Min. de Planeamiento y Coord., Rep. of Bolivia, La Paz, Bolivia, Aug. 1977 p 1-14 Transl. by SCITRAN, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75090) Avail: NTIS HC A02/MF A01 CSCL 05B

The use of photographs from satellites to assist in census operations is discussed. Principles of selecting the sources of cartographic information are outlined, and the use of LANDSAT pictures in census cartography is examined. Author

N78-19582*# National Aeronautics and Space Administration, Washington, D. C.
BACKGROUND AND PRINCIPLE APPLICATIONS OF REMOTE SENSING IN MEXICO
Jose Armando Diez Perez Mar. 1978 13 p Transl. into ENGLISH of conf. paper on "Antecedentes y Principales Aplicaciones de la Percepcion Remote en Mexico" Presented at the UN/FAO Regional Training Seminar on the Appl. of Satellite Remote Sensing, La Paz, Bolivia, 1-9 Dec. 1977 p 1-14 Transl. by SCITRAN, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75091) Avail: NTIS HC A02/MF A01 CSCL 08F

Remote sensing, or the collection of information from objectives at a distance, crystallizes the interest in implementing techniques which assist in the search for solutions to the problems raised by the detection, exploitation, and conservation of the natural resources of the earth. An attempt is made to present an overview of the studies and achievements which have been obtained with remote sensing in Mexico. Author

N78-19583# Synectics Corp., Allison Park, Pa.
THE CARTOGRAPHIC SYSTEM Final Report
John Decker, Aldo DiPasqua, and Allen Lazzara Nov. 1977 64 p refs
(Contract F30602-75-C-0329)
(AD-A049228; C-T0679-W; RADC-TR-77-373) Avail: NTIS HC A04/MF A01 CSCL 08/2

This report describes a cartographic digitizing system developed for the Instituto Geografico Militare Italiano. The cartographic system was designed to provide a means to rapidly acquire digital files from analog cartographic data using manual and computer interactive techniques. This objective is effected by the use of tutorial displays which guide the operator in the digitizing session and indicate his rate of accomplishment. The system provides for verification plotting on a high speed drum plotter and for final product plotting on the IGMI contraves plotter. Author (GRA)

N78-19584# Army Engineer Topographic Labs., Fort Belvoir, Va.
A SELECTED BIBLIOGRAPHY OF CORPS OF ENGINEERS REMOTE SENSING REPORTS
Theodore C. Vogel and E. James Books Aug. 1977 228 p refs
(AD-A049351; ETL-0126) Avail: NTIS HC A11/MF A01 CSCL 15/4

The purpose of this bibliography is to present a selected list of remote sensing technology reports and papers published by the U.S. Army Corps of Engineer Divisions, Districts, and Research Laboratories. This bibliography documents the importance of remote sensing technology to the Corps of Engineers and the many and varied tasks to which it has been applied. Author (GRA)

N78-19585# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
APPLICATIONS OF REMOTE SENSING IN THE BOSTON URBAN STUDIES PROGRAM, PART 1
Carolyn J. Merry and Harlan L. McKim Jun. 1977 22 p refs
(AD-A049285; CRREL-77-13-Pt-1) Avail: NTIS HC A02/MF A01 CSCL 13/2

The cost effectiveness of remote sensing techniques was compared to that of the conventional techniques used by the U.S. Army Engineer Division, New England, in the Boston Harbor - Eastern Massachusetts Metropolitan Area study. A total of 6 level I, 18 level II, and 18 level III land use categories were mapped from NASA RB-57/RC-8 high altitude aircraft photography for six selected 7 1/2-minute quadrangles located in the Boston area. Watershed and political boundaries could not be mapped from the NASA photography. Impervious surfaces and curb lengths were mapped from low altitude aircraft photography obtained with a Zeiss RMK 15/23 camera system (measured scale 1:3500) for two sites in the Boston South and Newton quadrangles. The remote sensing procedures used in this study usually provided much greater detail than conventional procedures. The remote sensing procedures were not always cost-effective when compared to the conventional procedures, but they were always more accurate. Therefore, remote sensing techniques should be used and appropriate photographic resolution and scale factors taken into consideration when mapping land use, curb density and impervious surfaces for use in the STORM (storage, treatment, overflow, runoff) model. Author (GRA)

N78-19586# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
APPLICATIONS OF REMOTE SENSING IN THE BOSTON URBAN STUDIES PROGRAM, PART 2
Carolyn J. Merry and Harlan L. McKim Jun. 1977 55 p
(AD-A049286; CRREL-77-13-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 13/2
For abstract, see N78-19585.

N78-19587# Advisory Group for Aerospace Research and Development, Paris (France).
APPLICATIONS OF REMOTE SENSING TO OCEAN SURVEILLANCE
Sep. 1977 277 p refs In ENGLISH and FRENCH AGARD Lecture Series presented at Oslo, 3-4 Oct. 1977; Den Helder, Netherlands, 6-7 Oct. 1977; Rome, 11-12 Oct. 1977
(AGARD-LS-88; ISBN-92-835-0202-7) Avail: NTIS HC A13/MF A01

The mathematical tools and their applications to the problems of resolving, recognizing and identifying targets and sources of activities in the ocean are described. described. For individual titles, see N78-19588 through N78-19597.

N78-19588# Office of Naval Research, Arlington, Va.
REMOTE SENSING IN OCEAN SURVEILLANCE: PROMISES, PROBLEMS AND PERSPECTIVES
Robert K. Geiger *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 13 p (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

The U.S. Navy's mission and need for global real time information of the environmental factors that affect naval operations are discussed. It is said that the potential of remote sensing technology for ocean surveillance needs to be developed through a program of research and engineering and a coordinated exchange of information among the disciplinary scientists, industry, and the military commanders who must interpret remotely sensed data for tactical and strategic decisions. Author

N78-19589# Department of the Navy, Washington, D. C.
OPERATIONAL REQUIREMENTS AND PROBLEMS
R. N. Keeler *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 4 p (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

In general, surveillance functions for naval forces, with or without air support are: (1) area surveillance for early warning; (2) over-the-horizon detection, classification and targeting for launch of offensive weapons; and (3) threat detection. Each of these functions levies distinct requirements for upgrading the current surveillance system, but all requirements can be grouped under three general headings. The first is improved sensors. These would be active and passive, and organic or remote. The second general heading in location or identification technique, and the third is data transfer analysis or dissemination or that aspect of command, control and communications. Along with the surveillance functions and requirement, the problem areas related to some of the more critical elements of the threat spectrum are considered. Author

N78-19590# Cologne Univ. (West Germany). Inst. of Geophysics and Meteorology.
RADIATION AND ENVIRONMENTAL PHYSICS REFRESHER
Erhard Raschke *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 13 p refs (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

Basic facts of radiative transfer theory and of physical and radiative transfer properties of the atmosphere and oceans are briefly outlined. Author

N78-19591# Naval Research Lab., Washington, D. C. Space Science Div.
MICROWAVE SCANNING RADIOMETRY
James P. Hollinger *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 11 p refs (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

The basic principles of microwave radiometry including a description of antenna properties, a definition of antenna temperature, brightness temperature, and system temperature and a discussion of measurement techniques and accuracies are briefly presented. Then the microwave signals to be expected from calm and rough seas, sea ice, ships and ship wakes, oil slicks, and terrain as well as the attenuation and radiation from the atmosphere are described. Detailed description and the specifications and performance of existing aircraft-borne scanners are given. Selected measurements from these imaging systems are presented to demonstrate their application. Author

N78-19592# British Aircraft Corp. (Operating) Ltd., Bristol (England).
MICROWAVE SCANNING RADIOMETRY (APPLICATIONS)
E. P. L. Windsor and H. McD. Mooney *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 25 p (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

The characteristics of satellite borne passive microwave radiometer described in terms of their potential sensitivity in measurement of physical parameters together with the spatial resolution and global coverage achievable. The application of similar techniques to aircraft borne systems is also discussed. Author

N78-19593# Tetra Tech, Inc., Pasadena, Calif.
INFRARED RADIOMETRY AND VISIBLE SPECTROMETRY
Henric Hodara and Willard H. Wells *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 47 p (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

An equation is derived that describes radiometric temperature fluctuations and identifies two major sources of error that mask the true sea temperature changes: humidity fluctuation in the air column between the sea surface and the radiometer, and reflected sky radiance from the rough sea surface. These masking effects are minimized by suitable design of the radiometer. Typical power spectra calculated from radiometric measurements are presented. Author

N78-19594*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VISIBLE AND INFRARED IMAGING RADIOMETERS FOR OCEAN OBSERVATIONS
W. L. Barnes *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 20 p refs (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01 CSCL 20F

The technology of visible and infrared imaging sensors designed for the remote monitoring of the oceans is assessed. Emphasis is placed on multichannel scanning radiometers that are either operational or under development. Present design practices and parameter constraints are discussed. Airborne sensor systems examined include the Ocean Color Scanner (OCS) and the Ocean Temperature Scanner (OTS). The Coastal Zone Color Scanner (CZCS) and Advanced Very High Resolution Radiometer (AVHRR), are reviewed with emphasis on design specifications, expected completion, and anticipated performance. Finally, recent technology advances and their probable impact on sensor design are examined. Author

N78-19595# Thomson-CSF, Malakoff (France).
SIDEWAYS-LOOKING RADAR (SLR) USING A SYNTHETIC AERIAL
J. Genuist *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 22 p In ENGLISH and FRENCH (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

The sideways-looking radar with synthetic aerial enables a very high resolution image to be obtained of the terrain overflown by an aircraft. The radar range resolution along the direction perpendicular to the path of the aircraft is obtained with a very fine pulse transmission-reception, using pulse compression technique. The longitudinal resolution, along the path of the aircraft is obtained by processing the Doppler signal. Two categories processing were tried: processing by simple filtering and processing by correlation. Different experimental results are presented for each of the processes, analysing the advantages and disadvantages. Author

N78-19596# Genoa Univ. (Italy).
FUNDAMENTALS OF ELF COMMUNICATION AND DETECTION
Giorgio Tacconi *In* AGARD Appl. of Remote Sensing to Ocean Surveillance Sep. 1977 50 p refs Prepared in cooperation

with CNR, Genoa (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

The propagation of waves in layered media and the inherent possibilities of transferring information from one layer to another or within a layer, can be used for communications, detection, or evaluation of structural anomalies of the geological zones in which the propagation phenomenon takes place. A conceptual physical-mathematical introduction is given taking into account the environmental structure of the natural man-made noise and the boundaries conditions. Some practical applications in communications, detection and environmental studies are shown. Features and properties for different scenarious of propagation are considered, together with limitations and the dependence on technology of the achievement of certain operational performances. Author

N78-19597# Naval Ocean Systems Center, San Diego, Calif.
ELECTRIC AND MAGNETIC SENSING SYSTEMS: APPLICATIONS
Frank Chilton (Science Applications, Inc., Palo Alto, Calif.), Lowell Wood (Lawrence Livermore Lab., Livermore, Calif.), and Rod Buntzen *In* AGARD Appl. of Remote Sensing to Ocean Surveillance, Sep. 1977 26 p refs (For availability see N78-19587 10-43)
Avail: NTIS HC A13/MF A01

The underlying principles of electric and magnetic sensing are reviewed and some of the more recent advances in the associated technologies are discussed. Some insight into the use of such systems in ocean surveillance are provided. Author

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N78-19598 Texas Univ., Austin.
A DYNAMIC MODEL FOR THE EFFICIENT UTILIZATION OF EXHAUSTIBLE ENERGY RESOURCES Ph.D. Thesis
Charles Banks McLane 1977 207 p
Avail: Univ. Microfilms Order No. 77-29065

A control theoretic model for the study of optimality in a large dynamic interfuel substitution system was presented. Given a set of energy resources, costs for energy conversion technologies, exogenous demands categorized by substitution possibilities, and bounds on rates of conversion to alternative fuels, the model generates families of dynamic resource allocations that minimize the discounted cost of energy production over a planning horizon. The mathematical solution was based on Pontryagin's maximum principle. Strong structure in the Hamiltonian permits the development of an extremely efficient algorithm for solving the bounded derivative control problem. Dissert. Abstr.

N78-19599* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELECTIVE COATING FOR SOLAR PANELS Patent
Glen E. McDonald, inventor (to NASA) Issued 25 Oct. 1977 6 p Filed 22 Dec. 1975 Supersedes N76-15603 (14 - 06, p 0741)
(NASA-Case-LEW-12159-1; US-Patent-4,055,707; US-Patent-Appl-SN-643041; US-Patent-Class-428-652; US-Patent-Class-126-270; US-Patent-Class-427-160; US-Patent-Class-428-667; US-Patent-Class-428-679) Avail: US Patent Office CSCL 10A

The energy absorbing properties of solar heating panels are improved by depositing a black chrome coating of controlled thickness on a specially prepared surface of a metal substrate. The surface is prepared by depositing a dull nickel on the substrate, and the black chrome is plated on this low emittance surface to a thickness between 0.5 micron and 2.5 microns.
Official Gazette of the U.S. Patent Office

N78-19600*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GUNTERSVILLE WORKSHOP ON SOLAR-TERRESTRIAL STUDIES
1977 71 p Presented at University of Alabama in Huntsville/NASA Workshop, 13-17 Oct. 1977, Lake Guntersville State Park Convention Center, Guntersville, Alabama
(NASA-CP-2037) Avail: NTIS HC A04/MF A01 CSCL 10A

The separation of purely solar physics from magnetospheric physics, and the effects of solar activity on geomagnetic activity are investigations which can be accomplished using the shuttle orbiter in an extended sortie mode, or an unmanned solar terrestrial observatory powered by the power module in an extended duration mode. When the power module is used with the shuttle in a sortie support mode, both the instrument capacity and the time in orbit of the orbiter can be increased several fold. In the free-flyer mode, the power module would be capable of providing power, basic attitude control, basic thermal control and housekeeping communications for unmanned, large, independent mission payloads in low earth orbit for periods of 6 months or longer. Instrument requirements for interdisciplinary joint observational programs are discussed for studies of the magnetosphere, the atmosphere, sun-weather relationships. Description summary charts of the power module are included. Author

N78-19601*# Solaron Corp., Denver, Colo.
PROTOTYPE SOLAR HEATING AND COOLING SYSTEMS, INCLUDING POTABLE HOT WATER Quarterly Report, 1 Jul. - 9 Nov. 1977
Don Bloomquist and Rodney L. Oonk Dec. 1977 126 p
(Contract NAS8-32249)
(NASA-CR-150576) Avail: NTIS HC A07/MF A01 CSCL 10A

Progress made in the development, delivery, and support of two prototype solar heating and cooling systems including potable hot water is reported. The system consists of the following subsystems: collector, auxiliary heating, potable hot water, storage, control, transport, and government-furnished site data acquisition. A comparison of the proposed Solaron Heat Pump and Solar Desiccant Heating and Cooling Systems, installation drawings, data on the Akron House at Akron, Ohio, and other program activities are included. Author

N78-19602*# IBM Federal Systems Div., Huntsville, Ala.
SITE SELECTION FOR MSFC OPERATIONAL TESTS OF SOLAR HEATING AND COOLING SYSTEMS
10 Feb. 1978 49 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150537; IBM-78W-00009) Avail: NTIS HC A03/MF A01 CSCL 10A

The criteria, methodology, and sequence aspects of the site selection process are presented. This report organized the logical thought process that should be applied to the site selection process, but final decisions are highly selective. Author

N78-19603*# Honeywell, Inc., Minneapolis, Minn. Energy Resource Center.
SOLAR HEATING AND COOLING SYSTEMS DESIGN AND DEVELOPMENT Quarterly Report
11 Nov. 1977 18 p Prepared for DOE
(Contract NAS8-32093)
(NASA-CR-150542; F34370QR-106) Avail: NTIS HC A02/MF A01 CSCL 10A

The development and delivery of eight prototype solar heating and cooling systems for installation and operational test was reported. Two heating and six heating and cooling units will be delivered for single family residences, multiple family residences and commercial applications. Author

N78-19604*# IBM Federal Systems Div., Huntsville, Ala.
SIMS PROTOTYPE SYSTEM 2 TEST RESULTS: ENGINEERING ANALYSIS
Jan. 1978 46 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150544; IBM-78W-0003) Avail: NTIS

HC A03/MF A01 CSCL 10A

The testing, problems encountered, and the results and conclusions obtained from tests performed on the IBM Prototype System 2, solar hot water system, at the Marshall Space Flight Center Solar Test Facility was described. System 2 is a liquid, non draining solar energy system for supplying domestic hot water to single residences. The system consists of collectors, storage tank, heat exchanger, pumps and associated plumbing and controls. Author

N78-19605*# Life Sciences Engineering, Morrison, Colo.
INSTALLATION PACKAGE FOR AIR FLAT PLATE COLLECTOR
Oct. 1977 26 p Prepared for DOE
(Contract NAS8-32261)
(NASA-CR-150536) Avail: NTIS HC A03/MF A01 CSCL 10A

The Solar 2 dimensions are four feet by eight feet by two and one half inches. The collector weighs 130 pounds and has an effective solar collection area of over 29.5 square feet. This area represents 95 percent of the total surface of the collector. The installation, operation and maintenance manual, safety hazard analysis, special handling instructions, materials list, installation concept drawings, warranty and certification statement are included in the installation package. Author

N78-19606*# Solar Engineering and Mfg. Co., Ft. Lauderdale, Fla.
PROTOTYPE SOLAR DOMESTIC HOT WATER SYSTEMS Quarterly Reports, Nov. 1976 - Sep. 1977
Feb. 1978 19 p Prepared for DOE
(Contract NAS8-32248)
(NASA-CR-150545) Avail: NTIS HC A02/MF A01 CSCL 10A

Construction of a double wall heat exchanger using soft copper tube coiled around a hot water storage tank was completed and preliminary tests were conducted. Solar transport water to tank potable water heat exchange tests were performed with a specially constructed test stand. Work was done to improve the component hardware and system design for the solar water heater. The installation of both a direct feed system and a double wall heat exchanger system provided experience and site data to enable informative decisions to be made as the solar market expands into areas where freeze protection is required. J.C.S.

N78-19607# National Solar Heating and Cooling Information Center, Rockville, Md.
A FORUM ON SOLAR ACCESS
Jul. 1977 81 p refs Proc. held at New York, 28 Jul. 1977 Sponsored in part by DOE
Avail: NTIS HC A05/MF A01

The Forum on Solar Access was held to analyze various approaches to protecting access to sunlight. Presently, access to sunlight may be jeopardized by certain zoning regulations, architectural controls, and shade from structures and vegetation. The proceedings, as part of New York State legislation, should be of use to other state legislatures in developing policies on the subject of solar access. Author

N78-19608*# National Aeronautics and Space Administration. Pasadena Office, Calif.
METHOD AND APPARATUS FOR MEASURING MINORITY CARRIER LIFETIMES AND BULK DIFFUSION LENGTH IN P-N JUNCTION SOLAR CELLS Patent Application
Oldwig VonRoos, inventor (to NASA) (JPL) Filed 16 Dec. 1977 20 p
(Contract NAS7-100)
(NASA-Case-NPO-14100-1; US-Patent-Appl-SN-861391) Avail: NTIS HC A02/MF A01 CSCL 10A

Carrier lifetimes and bulk diffusion length are qualitatively measured as a means for qualification of a P-N junction photovoltaic solar cell by alternately applying high frequency (blue) monochromatic light pulses and low frequency (red) monochromatic light pulses to the cell while it is irradiated by light from a solar simulator, and synchronously displaying the derivative of the output voltage of the cell on an oscilloscope. This output voltage is a measure of the lifetimes of the minority carriers (holes) in the diffused N layer and majority carriers (electrons) in the bulk P material, and of the diffusion length of the bulk silicon. By connecting a reference cell in this manner with a test cell to be tested in reverse parallel, the display of a test cell that matches the reference cell will be a substantially zero output. NASA

N78-19609*# National Aeronautics and Space Administration. Pasadena Office, Calif.
MICROWAVE POWER CONVERTER Patent Application
Richard M. Dickinson, inventor (to NASA) (JPL) Filed 8 Dec. 1977 12 p
(Contract NAS7-100)
(NASA-Case-NPO-14068-1; US-Patent-Appl-SN-858769) Avail: NTIS HC A02/MF A01 CSCL 10A

A simple orbiting space station that converts sunlight into microwave power for transmission to earth was devised. The basic concept is to use a large mirror to concentrate sunlight onto a piston so that the radiation pressure of the sunlight moves the piston to compress a microwave cavity. Microwaves resonating in the cavity undergo an increase in frequency and therefore in power as the cavity is compressed. When the piston is close to the end wall, a switch is opened to allow most of the microwave power to pass to an antenna which radiates it to the earth. A rotary wheel with blades are turned by concentrated sunlight from a mirror. As the blade enters the space between a pair of parallel plates, it begins compressing the space to increase the microwave energy, some of which passes out through a switch. When the blade reaches position, the remaining microwave energy leaks under that blade but is stopped by the next blade. NASA

N78-19610*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN OVERVIEW OF US ENERGY OPTIONS: SUPPLY- AND DEMAND-SIDE HISTORY AND PROSPECTS
A. S. Hirshberg 25 Feb. 1977 73 p refs
(Contract NAS7-100)
(NASA-CR-155946; JPL-PUB-77-77) Avail: NTIS HC A04/MF A01 CSCL 10B

An overview was provided of nonsolar energy policy options available to the United States until solar energy conversion and utilization devices can produce power at a cost competitive with that obtained from fossil fuels. The economics of the development of new fossil fuel sources and of mandatory conservation measures in energy usage were clarified in the context of the historic annual rate of increase in U.S. energy demand. An attempt was made to compare the costs and relative efficiencies of energy obtainable from various sources by correlating the many confusing measurement units in current use. Author

N78-19611*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DIFFUSION OF THE USE OF NEW ENERGY TECHNOLOGY AS A CONTEXT FOR AN OVERVIEW OF SOLAR ENERGY TECHNOLOGIES
A. S. Hirshberg Mar. 1977 58 p refs
(Contract NAS7-100)
(NASA-CR-155942; JPL-Pub-77-76) Avail: NTIS HC A04/MF A01 CSCL 10A

The process by which new solutions to the energy dilemma are generated and used as a context for an overview of solar energy economics and technologies. Author

N78-19612*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
UTILIZATION REQUIREMENTS. A SOUTHERN CALIFORNIA GAS COMPANY PROJECT SAGE REPORT: UTILIZATION REQUIREMENTS
R. Barbieri, R. Schoen (Calif. Univ., Los Angeles), and A. S. Hirshberg Jan. 1978 42 p
(Contract NAS7-100)
(NASA-CR-155948; JPL-Pub-77-49) Avail: NTIS HC A03/MF A01 CSCL 10B

Utilization requirements are given and comparisons made of two phase III SAGE (solar assisted gas energy) installations in California: (1) a retrofit installation in an existing apartment building in El Toro, and (2) an installation in a new apartment building in Upland. Such testing in the field revealed the requirements to be met if SAGE-type installations are to become commercially practical on a widespread basis in electric and gas energy usage. Author

N78-19613*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PUBLIC POLICY ISSUES. A SOUTHERN CALIFORNIA GAS COMPANY PROJECT SAGE REPORT
R. Barbieri and A. S. Hirsberg Jan. 1978 24 p refs
(Contract NAS7-100)
(NASA-CR-155945; JPL-Pub-77-47) Avail: NTIS HC A02/MF A01 CSCL 10B

The use of solar energy to stretch our supplies of fossil fuels was investigated. Project SAGE (semi-automated ground environment) addresses itself to one application of this goal, solar assistance in central water heating systems for multifamily projects. Public policy issues that affect the rate of adoption of solar energy systems were investigated and policy actions were offered to accelerate the adoption of SAGE and other solar energy systems. Author

N78-19614*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LSSA (LOW-COST SILICON SOLAR ARRAY) PROJECT Quarterly Report, Apr. - Jun. 1977
Irene Mallock Jun. 1977 72 p refs Prepared for DOE
(Contract NAS7-100)
(NASA-CR-155944; JPL-PUB-78-9; DOE/JPL-1012-77/4; QR-5) Avail: NTIS HC A04/MF A01 CSCL 10A

Work performed in the field of photovoltaic research by the low cost silicon solar array project of jet propulsion laboratory was described. Background technical information was also furnished. Author

N78-19615*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROCEEDINGS OF SMALL POWER SYSTEMS SOLAR ELECTRIC WORKSHOP. VOLUME 2: INVITED PAPERS
R. Ferber, ed. Feb. 1978 228 p Workshop held at Aspen, Colo., 10-12 Oct. 1977 Prepared for DOE
(Contracts NAS7-100; EX-76-A-29-1060)
(NASA-CR-155940; JPL-Pub-78-100; DOE/JPL-1060-78/1)
Avail: NTIS HC A11/MF A01 CSCL 10A

The focus of this work shop was to present the committment to the development of solar thermal power plants for a variety of applications including utility applications. Workshop activities included panel discussions, formal presentations, small group interactive discussions, question and answer periods, and informal gatherings. Discussion on topics include: (1) solar power technology options; (2) solar thermal power programs currently underway at the DOE, JPL, Electric Power Research Institute (EPRI), and Solar Energy Research Institute (SERI); (3) power options competing with solar; (4) institutional issues; (5) environmental and siting issues; (6) financial issues; (7) energy storage; (8) site requirements for experimental solar installations, and (9) utility planning. Author

N78-19616*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND TURBINE STRUCTURAL DYNAMICS
Dean R. Miller, ed. 1978 280 p refs Workshop held at Cleveland, 15-17 Nov. 1977; sponsored by DOE
(NASA-CP-2034; DOE-Conf-771148; E-9518) Avail: NTIS HC A13/MF A01 CSCL 10A

A workshop on wind turbine structural dynamics was held to review and document current United States work on the dynamic behavior of large wind turbines, primarily of the horizontal-axis type, and to identify and discuss other wind turbine configurations that may have lower cost and weight. Information was exchanged on the following topics: (1) Methods for calculating dynamic loads; (2) Aeroelasticity stability (3) Wind loads, both steady and transient; (4) Critical design conditions; (5) Drive train dynamics; and (6) Behavior of operating wind turbines. For individual titles, see N78-19617 through N78-19641.

N78-19617*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF COMPUTER CODES FOR CALCULATING DYNAMIC LOADS IN WIND TURBINES
David A. Spera *In its* Wind Turbine Structural Dyn. 1978 p 1-13 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

The development of computer codes for calculating dynamic loads in horizontal axis wind turbines was examined, and a brief overview of each code was given. The performance of individual codes was compared against two sets of test data measured on a 100 KW Mod-0 wind turbine. All codes are aeroelastic and include loads which are gravitational, inertial and aerodynamic in origin. Author

N78-19618*# General Electric Co., Philadelphia, Pa.
MOD-1 WTG DYNAMIC ANALYSIS
Clyde V. Stahle, Jr. *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 15-29 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

An analysis of the MOD-1 2000 kW horizontal axis wind turbine was given. The MOD-1 design was briefly described, and the analysis used to evaluate the dynamic loads and structural interactions is discussed. The resonant frequency placement, the treatment of unsteady wind loading, and the dynamic load sensitivity to frequency shifts were reviewed for the design. Author

N78-19619*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMPLIFIED MODELING FOR WIND TURBINE MODAL ANALYSIS USING NASTRAN
Timothy L. Sullivan *In its* Wind Turbine Structural Dyn. 1978 p 31-38 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

A detailed finite element model of the MOD-0 wind turbine tower was reduced to six beam elements (stick model). The method used to calculate the properties of the beam elements in the stick model was explained and the accuracy of the stick model in predicting natural frequencies and mode shapes was examined. Computer times were compared and several applications where the stick model was used are described. From results obtained from the MOD-0 tower it is concluded that a tower of this type can be modeled as a simple cantilever beam for modal analysis. However, this model should be limited to tower torsional modes and tower bending modes where the mode shape resembles a cantilever beam first bending mode shape. Author

N78-19620*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
USE OF ASYMPTOTIC METHODS IN VIBRATION ANALYSIS
Holt Ashley *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 39-52 refs (For availability see N78-19616 10-44)
(Grant AF-AFOSR-2712-74)
Avail: NTIS HC A13/MF A01 CSCL 10A

The derivation of dynamic differential equations, suitable for studying the vibrations of rotating, curved, slender structures was examined, and the Hamiltonian procedure was advocated for this purpose. Various reductions of the full system are displayed, which govern the vibrating troposkien when various order of magnitude restrictions are placed on important parameters. Possible advantanges of the WKB asymptotic method for solving these classes of problems are discussed. A special case of this method is used illustratively to calculate eigenvalues and eigenfunctions for a flat turbine blade with small flexural stiffness. Author

N78-19621*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
AEROELASTIC ANALYSIS OF WIND ENERGY CONVERSION SYSTEMS
John Dugundji *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 53-60 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

An aeroelastic investigation of horizontal axis wind turbines is described. The study is divided into two simpler areas; (1) the aeroelastic stability of a single blade on a rigid tower; and (2) the mechanical vibrations of the rotor system on a flexible tower. Some resulting instabilities and forced vibration behavior are described. Author

N78-19622*# Toledo Univ., Ohio.
AEROELASTIC STABILITY OF WIND TURBINE BLADES

Krishna Rao V. Kaza *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 61-69 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

The second degree nonlinear aeroelastic equations for a flexible, twisted, nonuniform wind turbine blade were developed using Hamilton's principle. The derivation of these equations has its basis in the geometric nonlinear theory of elasticity. These equations with periodic coefficients are suitable for determining the aeroelastic stability and response of large wind turbine blades. Methods for solving these equations are discussed. Author

N78-19623*# Battelle Pacific Northwest Labs., Richland, Wash.
FLOW FIELD ANALYSIS
William C. Cliff and M. Gary Verholek *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 71-76 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

The average mean wind speed integrated over a disk is shown to be extremely close to the mean value of wind speed which would be measured at the center of a disk for most geometries in which a WECS (Wind Energy Conversion System) would operate. Field test results are presented which compare instantaneous records of wind speed integrated over a disk with the wind speed measured at the center of the disk. The wind field that a rotating element would experience is presented which was synthesized from the outputs of an array of anemometers. Author

N78-19624*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
FLUTTER OF DARRIEUS WIND TURBINE BLADES
Norman D. Ham *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 77-93 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

The testing of Darrieus wind turbines has indicated that under certain conditions, serious vibrations of the blades can occur, involving flatwise bending, torsion, and chordwise bending. A theoretical method of predicting the aeroelastic stability of the coupled bending and torsional motion of such blades with a view to determining the cause of these vibrations, and a means of suppressing them was developed. Author

N78-19625*# Kaman Aerospace Corp., Bloomfield, Conn.
ANALYTICAL TESTING TECHNIQUES
Robert Jones *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn, 1978 p 95-101 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

Structural dynamic analytical testing techniques can be a tool to determine the source of structural dynamic problems and the solution to these problems. Analytical testing techniques are based upon dynamic testing methods and analysis of test results. These methods apply primarily to constructed wind turbine systems. A summary of these methods is presented. Author

N78-19626* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF WIND TURBINE FOUNDATION
Suey T. Yee *In its* Wind Turbine Structural Dyn. 1978 p 103-108 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

The 200 kW Mod-0A wind turbine was modeled using a 3 lumped mass-spring system for the superstructure and a rotational spring for the foundation and supporting soil. Natural frequencies were calculated using soil elastic moduli varying from 3000 to 22,400 p.s.i. The reduction in natural frequencies from the rigid foundation case ranged up to 20 percent. Author

N78-19627*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF STATIC LOAD TEST OF THE MOD-0 BLADE
Dean R. Miller *In its* Wind Turbine Structural Dyn. 1978 p 109-116 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

A static load test was performed on the spare Mod-0 wind turbine blade to define load transfer at the root end of the blade, and to validate stress analysis of this particular type of blade construction (frame and stringer). Analysis of the load transfer from the airfoil skin to the shank tube predicted a step change in spanwise stress in the airfoil skin at station 81.5 inches (STA 81.5). For flatwise bending a 40% reduction in spanwise stress was predicted, and for edgewise bending a 6% reduction. Experimental results verified the 40% reduction for flatwise bending, but indicated about a 30% reduction for edgewise bending. Author

N78-19628*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DOE/NASA MOD-0 100KW WIND TURBINE TEST RESULTS
John C. Glasgow *In its* Wind Turbine Structural Dyn. 1978 p 117-150 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

The Wind Turbine demonstrates the capability of automatic unattended operation, including startup, achieving synchronism, and shutdown as dictated by wind conditions. During the course of these operations, a wealth of engineering data was generated. Some of the data which is associated with rotor and machine dynamics problems encountered, and the machine modifications incorporated as a solution are presented. These include high blade loads due to tower shadow, excessive nacelle yawing motion, and power oscillations. The results of efforts to correlate measured wind velocity with power output and wind turbine loads are also discussed. Author

N78-19629*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POWER OSCILLATION OF THE MOD-0 WIND TURBINE
Robert C. Seidel *In its* Wind Turbine Structural Dyn. 1978 p 151-156 (For availability see N78-19616 10-44)
Avail: NTIS CSCL 10A

The Mod-0 power has noise components with varying frequency patterns. Magnitudes reach more than forty percent power at the frequency of twice per rotor revolution. Analysis of a simple torsional model of the power train predicts less than half the observed magnitude and does not explain the shifting frequencies of the noise patterns. Author

N78-19630*# Kaman Aerospace Corp., Bloomfield, Conn.
DRIVE TRAIN DYNAMIC ANALYSIS
Nicholas Giansante *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 157-166 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

A method for parametric variations in drive train dynamic analysis is described. The method models the individual components of a drive system, forms the appropriate system interface coordinates and, calculates the system dynamic response at particular frequencies. Application of the method for prediction of the dynamic response characteristics of a helicopter transmission, and a comparison of results with test data are also included. Author

N78-19631*# General Electric Co., Philadelphia, Pa. Valley Forge Space Center.
MOD-1 WIND TURBINE GENERATOR ANALYSIS
Robert S. Barton *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 167-178 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

A general summary of the MOD-1 wind turbine generator control system and simulation is presented. Mechanical and speed stabilization control means to add drive train damping were mentioned and MOD-1 simulation results showing the effects of speed stabilization are displayed. Author

N78-19632*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHODS OF ATTENUATING WIND TURBINE ac GENERATOR OUTPUT VARIATIONS
Harold Gold *In its* Wind Turbine Structural Dyn. 1978 p 179-186

refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

Wind speed variation, tower blockage and structural and inertial factors produce unsteady torque in wind turbines. Methods for modifying the turbine torque so that steady torque is delivered to the coupled ac generator are discussed. The method that may evolve will be influenced by the power use that develops and the trade-offs of cost, weight and complexity. Author

N78-19633*# Massachusetts Inst. of Tech., Cambridge.
DYNAMICS OF DRIVE SYSTEMS FOR WIND ENERGY CONVERSION
Manuel Martinez-Sanchez *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 187-193 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

Calculations are performed to determine the dynamic effects of mechanical power transmission from the nacelle of a horizontal axis wind machine to the ground or to an intermediate level. It is found that resonances are likely at 2 or 4/REV, but they occur at low power only, and seem easily correctable. Large reductions are found in the harmonic torque inputs to the generator at powers near rated. Author

N78-19634*# Washington Univ., St. Louis, Mo.
SOME ALTERNATIVE DYNAMIC DESIGN CONFIGURATIONS FOR LARGE HORIZONTAL AXIS WECS
Kurt H. Hohenemser *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 195-218 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

The present U.S. development effort toward large horizontal axis WECS concentrates on the configuration with two rigid blades with collective pitch variation and a yaw gear drive. Alternative configurations without yaw gear drive were considered where the rotor is either selfcentering or where the yaw angle is controlled by blade cyclic pitch inputs. A prelimary evaluation of the dynamic characteristics for these alternative design configurations is presented. Author

N78-19635*# Boeing Co., Seattle, Wash.
FATIGUE LOAD SPECTRA FOR UPWIND AND DOWNWIND ROTORS
John S. Andrews *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 219-225 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

Effect of both alternating and mean load on the fatigue life of an upwind and downwind MOD-2 wind turbine system is presented. It was shown that the fatigue damage varies as the product of the stress range cubed and the maximum stress. Hence, the alternating flapwise load caused by tower shadow and wind gradient is an important factor in determining rotor blade life. Author

N78-19636*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF ROTOR LOCATION, CONING, AND TILT ON CRITICAL LOADS IN LARGE WIND TURBINES
D. A. Spera and D. C. Janetzke *In its* Wind Turbine Structural Dyn. 1978 p 227-236 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

Several large (1500 kW) horizontal rotor configurations were analyzed to determine the effects on dynamic loads of upwind downwind rotor locations, coned and radial blade positions, and tilted and horizontal rotor axis positions. Loads were calculated for a range of wind velocities at three locations in the structure: (1) the blade shank; (2) the hub shaft; and (3) the yaw drive. Blade axis coning and rotor axis tilt were found to have minor effects on loads. However, locating the rotor upwind of the tower significantly reduced loads at all locations analyzed. Author

N78-19637*# United Technologies Research Center, East Hartford, Conn.
COMPARISON OF BLADE LOADS OF FIXED AND FREE YAWING WIND TURBINE
Marvin C. Cheney and Richard L. Bielawa *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 237-242 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

The self regulating composite bearingless wind turbine utilizes an automatic pitch control concept and a completely unrestrained yawing degree of freedom. Aerodynamic moments caused by skewed flow provide the control to align the wind turbine with the wind. Model tests demonstrated the feasibility of the concept and analytical studies showed the free system to experience lower blade loads compared to the fixed system. Author

N78-19638*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIXED PITCH WIND TURBINES
David B. Fenn and Larry A. Viterna *In its* Wind Turbine Structural Dyn. 1978 p 243-254 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

Wind turbines designed for fixed pitch operation offer potential reductions in the cost of the machine by eliminating many costly components. It was shown that a rotor can be designed which produces the same energy annually as Mod-0 but which regulates its power automatically by progressively stalling the blades as wind speed increases. Effects of blade twist, taper, root cutout, and airfoil shape on performance are discussed as well as various starting technqiues. Author

N78-19639*# Akron Univ., Ohio.
RESEARCH OF LOW COST WIND GENERATOR ROTORS
Demeter G. Fertis and Robert S. Ross (Concept Development Inst, Inc., Hudson, Ohio) *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 257-260 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

A feasibility program determined that it would be possible to significantly reduce the cost of manufacturing wind generator rotors by making them of cast urethane. Several high modulus urethanes which were structurally tested were developed. A section of rotor was also cast and tested showing the excellent aerodynamic surface which results. A design analysis indicated that a cost reduction of almost ten to one can be achieved with a small weight increase to achieve the same structural integrity as expected of current rotor systems. Author

N78-19640*# Paragon Pacific, Inc., El Segundo, Calif.
PLANS FOR WIND ENERGY SYSTEM SIMULATION
Mark E. Dreier *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 261-264 (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

A digital computer code and a special purpose hybrid computer, were introduced. The digital computer program, the Root Perturbation Method or RPM, is an implementation of the classic floquet procedure which circumvents numerical problems associated with the extraction of Floquet roots. The hybrid computer, the Wind Energy System Time domain simulator (WEST), yields real time loads and deformation information essential to design and system stability investigations. Author

N78-19641*# Massachusetts Univ., Amherst. Mechanical Engineering Dept.
THE UMASS WIND FURNACE BLADE DESIGN
Duane E. Cromack *In* NASA. Lewis Res. Center Wind Turbine Structural Dyn. 1978 p 265-268 refs (For availability see N78-19616 10-44)
Avail: NTIS HC A13/MF A01 CSCL 10A

A brief description of the wind furnace concept is presented along with some preliminary performance data. Particular emphasis is placed on the design, construction, and manufacturing procedure for the 32.5 foot diameter GRP blades. Author

N78-19642*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL DATA AND THEORETICAL ANALYSIS OF AN OPERATING 100 kW WIND TURBINE
Bradford S. Linscott, John C. Glasgow, William D. Anderson (Lockheed California Co., Burbank), and Robert E. Donham (Lockheed California Co., Burbank) Jan. 1978 21 p refs Presented at 12th Intersoc. Energy Conversion Engr. Conf.,

Washington, D. C., 28 Aug. - 2 Sep. 1977; sponsored by Am. Nucl. Soc.
(Contract E(49-26)-1028)
(NASA-TM-73883; DOE/NASA/1028-78/15; E-9496) Avail: NTIS HC A02/MF A01 CSCL 10A

Experimental test data are correlated with analyses of turbine loads and complete system behavior of the ERDA-NASA 100 kW Mod-0 wind turbine generator over a broad range of steady state conditions, as well as during transient conditions. The deficit in the ambient wind field due to the upwind tower turbine support structure is found to be very significant in exciting higher harmonic loads associated with the flapping response of the blade in bending. Author

N78-19643*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC VILLAGE POWER APPLICATION: ASSESSMENT OF THE NEAR-TERM MARKET
Louis Rosenblum, William J. Bifano, William A. Poley, and Larry R. Scudder Jan. 1978 29 p refs
(Contract E(49-26)-1022)
(NASA-TM-73893; DOE/NASA/1022-78/25; E-9510) Avail: NTIS HC A03/MF A01 CSCL 10B

The village power application represents a potential market for photovoltaics. The price of energy for photovoltaic systems was compared to that of utility line extensions and diesel generators. The potential domestic demand was defined in both the government and commercial sectors. The foreign demand and sources of funding for village power systems in the developing countries were also discussed briefly. It was concluded that a near term domestic market of at least 12 MW min and a foreign market of about 10 GW exists. Author

N78-19644*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC WATER PUMPING APPLICATIONS: ASSESSMENT OF THE NEAR-TERM MARKET
Louis Rosenblum, William J. Bifano, Larry R. Scudder, William A. Poley, and James P. Cusik Mar. 1978 24 p refs
(Contract E(49-26)-1022)
(NASA-TM-78847; E-9566; DOE/NASA/1022-78/29) Avail: NTIS HC A02/MF A01 CSCL 10B

Water pumping applications represent a potential market for photovoltaics. The price of energy for photovoltaic systems was compared to that of utility line extensions and diesel generators. The potential domestic demand was defined in the government, commercial/institutional and public sectors. The foreign demand and sources of funding for water pumping systems in the developing countries were also discussed briefly. It was concluded that a near term domestic market of at least 240 megawatts and a foreign market of about 6 gigawatts exist. Author

N78-19645*# IBM Federal Systems Div., Huntsville, Ala.
SITE SELECTION FEASIBILITY FOR A SOLAR ENERGY SYSTEM ON THE FAIRBANKS FEDERAL BUILDING
22 Feb. 1978 46 p Revised Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150559; IBM-77W-0008-Rev) Avail: NTIS HC A03/MF A01 CSCL 10A

A feasibility study was performed for the installation of a solar energy system on the Federal Building in Fairbanks, Alaska, a multifloor office building with an enclosed parking garge. The study consisted of determining the collectable solar energy at the Fairbanks site on a monthly basis and comparing this to the monthly building heating load. Potential conventional fuel savings were calculated on a monthly basis and the overall economics of the solar system applications were considered. Possible solar system design considerations, collector and other system installation details, interface of the solar system with the conventional HVAC systems, and possible control modes were all addressed. Conclusions, recommendations and study details are presented. Author

N78-19646*# Contemporary Systems, Inc., Jaffrey, N. H.
SCHEDULES, TECHNICAL STATUS, AND PROGRAM ACTIVITIES IN THE DEVELOPMENT OF A SINGLE FAMILY SOLAR SPACE HEATING SYSTEM Contractor Report, 1 Nov. 1976 - 13 Oct. 1977
Mar. 1978 20 p refs Prepared for DOE
(Contract NAS8-32243)
(NASA-CR-150571) Avail: NTIS HC A02/MF A01 CSCL 10B

A collection of three quarterly reports are given covering the development of two prototype solar heating systems consisting of the following subsystems: collector, storage, control, transport, and site data acquisition. The two systems are being installed at York, Pennsylvania, and Manchester, New Hampshire. Author

N78-19647*# Artech Corp., Falls Church, Va.
THERMAL ENERGY STORAGE SUBSYSTEMS. A COLLECTION OF QUARTERLY REPORTS Contractor Report, 1 Oct. 1976 - 31 Dec. 1977
Jan. 1978 59 p Prepared for DOE
(Contract NAS8-32254)
(NASA-CR-150574) Avail: NTIS HC A04/MF A01 CSCL 10B

The design, development, and progress toward the delivery of three subsystems is discussed. The subsystem used a salt hydrate mixture for thermal energy storage. The program schedules, technical data, and other program activities from October 1, 1976, through December 31, 1977 are presented. Author

N78-19648*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETERMINATION OF THE ZINCATE DIFFUSION COEFFICIENT AND ITS APPLICATION TO ALKALINE BATTERY PROBLEMS
Charles E. May 1978 20 p refs Proposed for presentation at the Electrochemical Soc. Meeting, Pittsburgh, 15-20 Oct. 1978
(NASA-TM-73879; E-9486) Avail: NTIS HC A02/MF A01 CSCL 10C

The diffusion coefficient for the zincate ion at 24 C was found to be 9.9 X 10 to the minus 7th power squared cm per sec + or - 30 percent in 45 percent potassium hydroxide and 1.4 x 10 to the minus 7 squared cm per sec + or - 25 percent in 40 percent sodium hydroxide. Comparison of these values with literature values at different potassium hydroxide concentrations show that the Stokes-Einstein equation is obeyed. The diffusion coefficient is characteristic of the zincate ion (not the cation) and independent of its concentration. Calculations with the measured value of the diffusion coefficient show that the zinc concentration in an alkaline zincate half cell becomes uniform throughout in tens of hours by diffusion alone. Diffusion equations are derived which are applicable to finite size chambers. Details and discussion of the experimental method are also given. Author

N78-19649*# IBM Federal Systems Div., Huntsville, Ala.
DESIGN DATA BROCHURE: SIMS PROTOTYPE SYSTEM 2
Dec. 1977 51 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150558; IBM-7933656) Avail: NTIS HC A04/MF A01 CSCL 10A

Information is provided on the design and performance of the IBM SIMS Prototype System 2, solar domestic hot water system, for single family residences. The document provides sufficient data to permit procurement, installation, operation, and maintenance by qualified architectural engineers or contractors. Author

N78-19650*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.
INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION OF SUNWORKS (LIQUID) SOLAR COLLECTOR
Ken Shih Dec. 1977 34 p Prepared for DOE
(NASA-CR-150573; WYLE-TR-531-15) Avail: NTIS HC A03/MF A01 CSCL 10A

Test procedures used and test results obtained from an evaluation test program conducted on a single covered liquid solar collector under simulated conditions are presented. The test article was a flat plate solar collector using water as the heat transfer medium. The absorber plate was copper with copper tubes bonded by soft solder. The plate was coated with Enthone

selective black with an absorptivity factor of .87 approximately .92 and an emissivity factor of .10 approximately .20. A time constant test and incident angle modifier test were conducted to determine the transient effect and the incident angle effect on the collector. Author

N78-19651*# IBM Federal Systems Div., Huntsville, Ala. Space Systems Div.
OPERATIONS MANUAL: ON SITE MONITOR (OSM), SOLAR HEATING AND COOLING SYSTEMS
17 Oct. 1977 15 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150581; IBM-7934365) Avail: NTIS HC A02/MF A01 CSCL 10A

The on-site monitor is a portable device which, when connected to a solar system site data acquisition subsystem; allows readouts of clock and sensor data in voltage or engineering units at instrumented solar heating and cooling sites. The unit is described and procedures for its proper operation are presented. Author

N78-19652*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.
INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION OF THE SOLARON (AIR) SOLAR COLLECTOR
Jan. 1978 34 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150572; WYLE-TR-531-16) Avail: NTIS HC A03/MF A01 CSCL 10A

The test procedure used and the results obtained from an evaluation test program, conducted to obtain thermal performance data on a Solaron double glazed air solar collector under simulated conditions in a solar simulator are described. A time constant test and incident angle modifier test were also conducted to determine the transient effect and the incident angle effect on the collector. These results and the results of the collector load test are also discussed. The Solaron collector absorber plate is made of 24-gage steel, the coating is baked-on black paint, the cover consists of two sheets of 1/8-inch low-iron tempered glass, and the insulation is one thickness of 3 5/8-inch fiberglass batting. Author

N78-19653*# Wormser Scientific Corp., Stamford, Conn.
PROTOTYPE SOLAR HEATING AND HOT WATER SYSTEM
Quarterly Reports, 7 Oct. 1976 - 19 Oct. 1977
Oct. 1977 24 p Prepared for DOE
(Contract NAS8-32250)
(NASA-CR-150575) Avail: NTIS HC A02/MF A01 CSCL 10A

Progress is reported in the development of a solar heating and hot water system which uses a pyramidal optics solar concentrator for heating, and consists of the following subsystems: collector, control, transport, and site data acquisition. Improvements made in the components and subsystems are discussed. Author

N78-19654*# ECON, Inc., Princeton, N. J.
A STUDY OF SOME ECONOMIC FACTORS RELATING TO THE DEVELOPMENT AND IMPLEMENTATION OF A SATELLITE POWER SYSTEM
25 Jan. 1978 82 p refs
(Contract NAS8-32698)
(NASA-CR-150602; Rept-77-146-1) Avail: NTIS HC A05/MF A01 CSCL 10A

Areas are examined relating to the design, development and implementation of a satellite power system (SPS): an analysis of the effect of energy R&D programs in general and SPS in particular on optimal fossil fuel consumption patterns, a study of alternative uses of SPS technologies, and a study of the electric power market penetration potential for SPS. It is shown that a credible program of R&D on long-range energy alternatives leads to lower optimal prices for fossil fuels, resulting in large short-term benefits accruing to the specific program elements. Several alternative uses of SPS technologies were identified; however the markets for these technologies are generally quite diffuse and difficult to assess. The notable exception is solar array technology which has, potentially, a very large non-SPS market. It is shown that the market for SPS units derives from two components of demand: the demand created by growth in the electrical energy demand which leads to an increased demand for baseload generating capacity, and a demand created by the need to replace retiring capacity. Author

N78-19655*# AiResearch Mfg. Co., Torrance, Calif.
PROTOTYPE SOLAR HEATING AND COOLING SYSTEMS
Progress Report, Jul. 1976 - Dec. 1977
Mar. 1978 248 p Prepared for DOE
(Contract NAS8-32091)
(NASA-CR-150570) Avail: NTIS HC A11/MF A01 CSCL 10A

Prototype solar heating and cooling systems are described. Development, manufacture, test, system installation, maintenance, problem resolution, and performance evaluation are discussed. Author

N78-19656*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REDOX FLOW CELL DEVELOPMENT AND DEMONSTRATION PROJECT, CALENDAR YEAR 1976
Dec. 1977 48 p refs
(Contract E(49-28)-1002)
(NASA-TM-73873; E-9354; CONS/1002-3) Avail: NTIS HC A03/MF A01 CSCL 10A

The major focus of the effort was the key technology issues that directly influence the fundamental feasibility of the overall redox concept. These issues were the development of a suitable semipermeable separator membrane for the system, the screening and study of candidate redox couples to achieve optimum cell performance, and the carrying out of systems analysis and modeling to develop system performance goals and cost estimates. Author

N78-19657*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC POWER SYSTEM TESTS ON AN 8-KILOWATT SINGLE-PHASE LINE-COMMUTATED INVERTER
John B. Stover Feb. 1978 16 p refs
(Contract E(49-26)-1022)
(NASA-TM-78824; E-9527; DOE/NASA/1022-78/26) Avail: NTIS HC A02/MF A01 CSCL 10B

Efficiency and power factor were measured as functions of solar array voltage and current. The effects of input shunt capacitance and series inductance were determined. Tests were conducted from 15 to 75 percent of the 8 kW rated inverter input power. Measured efficiencies ranged from 76 percent to 88 percent at about 50 percent of rated inverter input power. Power factor ranged from 36 percent to 72 percent. Author

N78-19658*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESULTS OF MODULE ELECTRICAL MEASUREMENT OF THE DOE 46-KILOWATT PROCUREMENT
Henry B. Curtis Feb. 1978 20 p refs
(Contract E(49-26)-1022)
(NASA-TM-78829; E-9534; DOE/NASA/1022-78/27) Avail: NTIS HC A02/MF A01 CSCL 10B

Current-voltage measurements have been made on terrestrial solar cell modules of the DOE/JPL Low Cost Silicon Solar Array procurement. Data on short circuit current, open circuit voltage, and maximum power for the four types of modules are presented in normalized form, showing distribution of the measured values. Standard deviations from the mean values are also given. Tests of the statistical significance of the data are discussed. Author

N78-19659# Toronto Univ. (Ontario).
DYNAMICAL MODEL FOR THE CTS DEVELOPMENT MODEL SOLAR ARRAY UNDER THE INFLUENCE OF GRAVITY
G. B. Sincarsin May 1977 113 p refs
(UTIAS-TN-206; CN-ISSN-0082-5263) Avail: NTIS HC A06/MF A01 CSCL 10A

A detailed model for the CTS (Communications Technology Satellite) development model solar array (DMSA) is presented, accompanied by models for the dynamics of the array in both normal gravity and zero gravity environments. The major objective of the mathematical derivations, is the development of the gravity-associated terms in the model. Vectorial mechanics and

variational principles were used to derive the equations of motion for the DMSA under the influence of gravity. The equations resulting from each method were identical, proving a mutual check. A comparison was made between the predicted natural frequencies in the one-gravity and zero-gravity environments. The latter values were about 50% lower, as expected. Author

N78-19660# Power Conversion, Inc., Mount Vernon, N. Y.
MANUFACTURING METHODS AND TECHNOLOGY FOR HERMETICALLY SEALED LITHIUM SO SUB 2 CELL BATTERIES Quarterly Report, 1 Jan. - 31 Mar. 1977
T. Watson Apr. 1977 55 p
(Contract DAAB07-76-C-0042)
(AD-A048619; ECOM-76-0042-Q-03) Avail: NTIS HC A04/MF A01 CSCL 10/3

Effort is continuing on the MM and T program to establish the fabrication techniques and requirements to meet hardware production levels as specified in the subject contract. Hermetic cell samples are presently being fabricated and tested under the required thermal discharge profiles to demonstrate the feasibility of each cell design. Prototype hermetic battery models are being constructed to verify conformance to all dimensional and weight specifications. Such models will aid in the finalization of complete drawing packages for each of the battery types. These drawings will define all required cell/battery components, sub-assemblies and process specifications and will be accompanied by a detailed bill of material to insure proper configuration control. GRA

N78-19661# Washington State Univ., Pullman.
ENERGY CONSERVATION POLICY - OPPORTUNITIES AND ASSOCIATED IMPACTS. STUDY MODULE 1-A. VOLUME 1, SUMMARY REPORT Final Report
Walter R. Butcher and George W. Hinman 1977 123 p Sponsored by Northwest Policy Project, Portland, Oregon
(PB-274337/5) Avail: NTIS HC A06/MF A01 CSCL 10A

A number of conservation measures that could significantly reduce growth in the Pacific Northwest's demand for energy are identified. If the 19 principal measures discussed are universally adopted, future energy demands will be reduced approximately 35 percent from the levels which can be anticipated without further conservation actions. Tables are included which show the capital recovery periods for investments in a number of conservation measures in selected cases assuming different rates for energy price increases. GRA

N78-19662# Rockwell International Corp., Anaheim, Calif. Electronic Devices Div.
ADVANCED SEMICONDUCTOR TECHNOLOGY FOR ALTERNATE ENERGY SOURCES: dc TO ac INVERTERS
C. T. Kleiner 15 Nov. 1977 14 p refs Presented at the Alternative Energy Sources Symp., Miami Beach, Fla., 5-7 Dec. 1977
(AD-A048806; X77-1210/501) Avail: NTIS HC A02/MF A01 CSCL 10/2

Alternate or advanced energy conversion methods frequently require d-c to a-c conversion since the energy output must be synchronized with an existing utility grid. The objective of this paper is to describe various preliminary system concepts for interfacing advanced solid-state energy converters to the utility grid with a significant potential for reducing initial capital investment. Recent ERDA sponsored studies have identified the solid-state d-c to a-c inverter as a key element for further development. These studies indicated that an inverter synchronized to the utility grid can directly transform solar photovoltaic array generated energy to local load (residence) demand with any excess energy feedback to the utility grid. Where the solar energy is insufficient to supply the local load, it is supplemented by the utility grid. Several key issues were identified in the referenced studies. One of these involved the considerable weight and cost associated with the d-c to a-c Inverter/Transformer vs a Transformerless Inverter that would have 'Float' with respect to the power grid return. This paper addresses this issue as well as the anticipated solution to the problem using advanced semiconductor technology. GRA

N78-19663# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SOLAR ELECTRIC GENERATING SYSTEM RESOURCE REQUIREMENTS AND THE FEASIBILITY OF ORBITING SOLAR REFLECTORS M.S. Thesis
Rolf C. Enger Dec. 1977 187 p refs
(AD-A048908; AFIT/GEP/PH/77D-3) Avail: NTIS HC A09/MF A01 CSCL 10/1

The potential consumption of natural resources by four solar electric generating systems was evaluated. They included a terrestrial solar thermal, a terrestrial photovoltaic, an orbiting solar reflector, and a satellite solar power system. Each was evaluated on its projected consumption of materials, land, water, manpower, energy, and money. The evaluation demonstrated that, per megawatt of electrical generating capacity, the terrestrial systems would consume less resources mainly because they would not require massive space transportation and construction systems and expensive developmental programs. It was also shown that construction of terrestrial systems would require fewer technological advancements and would pose less of a threat to the environment. A feasibility study of orbiting solar reflectors demonstrated that single-mirror systems may be useful for intra-space power generation. The report contains a 47-item bibliography. Author (GRA)

N78-19664# GTE Labs., Inc., Waltham, Mass.
INORGANIC ELECTROLYTES Interim Report, Jan. 1976 - Oct. 1977
M. Domeniconi, K. Klinedinst, N. Marincic, C. Schlaikjer, and R. Staniewicz Oct. 1977 106 p refs
(Contract N00014-76-C-0524)
(AD-A048879) Avail: NTIS HC A06/MF A01 CSCL 10/3

Part I. Analyses of the Hazard Potentials of Various Reaction Modes and Materials Incidental to the Operation of Li/SOCl2 Cells; Part II. Preliminary Survey of Alternative Anode Materials Compatible with Oxychloride Catholytes; Part III. Preliminary Survey of Alternative Catholytes for Improved Lithium Cell Performance; Part IV. Reserve Mode Configurations of the Li/SOCl2 Cell; Part V. Determination of the Discharge Reaction Mechanisms in Li/SOCl2 Cells; Part VI. Investigation of Inorganic Liquid Oxidants as Cathode Reactants for Sea Water Batteries. GRA

N78-19665# California Univ., Livermore. Lawrence Livermore Lab.
ELECTROSTATIC DIRECT ENERGY CONVERTER PERFORMANCE AND COST SCALING LAWS
Myron A. Hoffman Aug. 1977 77 p refs
(Contract W-7405-eng-48)
(UCID-17560) Avail: NTIS HC A05/MF A01

Simplified equations were presented for each of the important loss mechanisms in both single stage direct converters and multistage venetian blind type direct converters. These equations can be used to estimate the efficiency and electric power output of the direct converter subsystem. Scaling relations for the cost of each major component in the direct converter subsystem were also given; these include the vacuum tank, direct converter modules, the dc power conditioning equipment, cryogenic vacuum pumping system and the thermal bottoming plant. The performance and cost scaling laws were developed primarily for use in overall fusion power plant systems codes. To illustrate their utility, cost-effectiveness studies of two specific reference direct converter designs were presented in terms of the specific capital costs for the direct converter subsystem alone. ERA

N78-19666# Oak Ridge National Lab., Tenn. Fusion Energy Div.
CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS Final Report, 1 Nov. 1972 - 30 Sep. 1976
H. M. Long, S. W. Schwenterly, M. M. Menon, R. H. Kernohan, W. J. Schill, C. C. Koch, D. M. Kroeger, D. J. Griffiths, J. O. Scarbrough, P. J. Jones et al 1976 240 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5941) Avail: NTIS HC A11/MF A01

The apparatus used in the experiments was summarized and briefly described. The entire body of results obtained during the course of the program on breakdown of liquid helium and on breakdown and partial discharge in thin polymer films was summarized. Recent work on ac breakdown for small gaps in supercritical helium is reported for temperatures and pressures

ranging from 4.2 to 12 K and 0.3 to 1.5 MPa. Possible mechanisms for helium breakdown in various thermophysical states were considered. Two further variations on the partial discharge experiments on polyethylene films are discussed, i.e., in the first, the sample was subjected to high mechanical compressive forces to simulate winding forces in an actual cable; in the second, the sample was prepared in a glove box with particular attention to cleanliness. ERA

N78-19667# Los Alamos Scientific Lab., N. Mex.
ASSESSMENT OF SOLAR HEATING AND COOLING TECHNOLOGY
J. D. Balcomb and J. E. Perry, Jr. May 1977 72 p refs
(Contract W-7405-eng-36)
(LA-6379-MS) Avail: NTIS HC A03/MF A01

In order to assess in detail the state of the technology for solar heating and cooling of buildings, five 2-day meetings were held. The meeting subjects were solar collectors, thermal storage, air conditioning and heat pumps, systems and controls, and non-engineering aspects of solar energy. A condensation of these meetings is offered, presenting for each topic discussed the details of the state of the art, the problem areas, and the objectives of necessary research and development. The existing state of technology for solar heating and cooling presents a mixed picture. Liquid-heating flatplate solar collectors, for example, are in a rather mature stage, and there is a small, viable industry producing components. Even here, however, there are problems of materials which, if solved, can reduce collector cost, improve performance, or increase lifetime. ERA

N78-19668# Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand).
HAWAII GEOTHERMAL PROJECT. WELL COMPLETION REPORT, HGP-A
Sep. 1976 48 p
(Contract EY-76-C-03-1093)
(TID-27312) Avail: NTIS HC A03/MF A01

The project was organized to focus the federal, state and local resources on the identification, generation and utilization of geothermal energy on the Big Island of Hawaii. The project was organized into geophysical, engineering, environmental, socio-economic and research drilling programs. The procedures followed and equipment used in the completion of the well are described. ERA

N78-19669# Lockheed-California Co., Burbank.
WIND ENERGY MISSION ANALYSIS, APPENDIX
Apr. 1976 268 p refs
(Contract EY-76-C-03-1075)
(SAN/1075-1/2) Avail: NTIS HC A12/MF A01

Information on the average power density of the wind for the U.S. and its territories, characteristics of the vertical axis machine, structural analysis details, aerodynamic analysis, cost factors, cost models, evaluation of utility applications, industrial cost of electricity, public acceptance, and environmental issues is presented. ERA

N78-19670# General Atomic Co., San Diego, Calif.
GAS TURBINE HTGR: A TOTAL ENERGY UTILIZATION OPTION
A. J. Goodjohn and S. H. Law (Northeast Utilities Serv. Co.) Jul. 1977 21 p refs Presented at Conf. on New Options in Energy Technol., San Francisco, 2-4 Aug. 1977 Submitted for publication
(Contract EY-76-C-03-0167-046)
(GA-A-14484; Conf-770824-1) Avail: NTIS HC A02/MF A01

The high-temperature gas-cooled reactor used high-pressure helium as the working fluid and a power conversion system that used a closed-cycle gas turbine coupled directly to an electrical generator. The primary cycle was capable of yielding thermal-to-electrical efficiencies of 40 percent or higher. The heat rejected from the system was at a sufficiently high temperature to be effectively utilized without incurring penalties to the basic efficiency of the primary cycle. ERA

N78-19671# Energy Research and Development Administration, Washington, D. C.
HOT DRY ROCK GEOTHERMAL ENERGY: STATUS OF EXPLORATION AND ASSESSMENT. REPORT NO. 1 OF THE HOT DRY ROCK ASSESSMENT PANEL
Jun. 1977 219 p
(ERDA-77-74) Avail: NTIS HC A10/MF A01

The status of knowledge of attempts to utilize hot dry rock (HDR) geothermal energy is summarized. It contains (1) descriptions or case histories of the ERDA-funded projects at Marysville, MT, Fenton Hill, NM, and Coso Hot Springs, CA; (2) a review of the status of existing techniques available for exploration and delineation of HDR; (3) descriptions of other potential HDR sites; (4) definitions of the probable types of HDR resource localities; and (5) an estimate of the magnitude of the HDR resource base in the conterminous United States. The scope is limited to that part of HDR resource assessment related to the determination of the extent and character of HDR, with emphasis on the igneous-related type. It is estimated that approximately 74 Q of heat is stored in these sites within the conterminous U.S. at depths less than 10 km and temperatures above 150 C, the minimum for power generation. ERA

N78-19672# National Academy of Public Administration, Washington, D. C. Panel on Institutional Aspects of the Energy Centers Concept.
INSTITUTIONAL ASPECTS OF THE ENERGY CENTERS CONCEPT
Mar. 1977 342 p refs
(Contract EX-76-C-16-3086)
(ANE-3086-1) Avail: NTIS HC A15/MF A01

Information is presented concerning the socio-economic impacts of nuclear energy centers; equity considerations relating to taxation and revenue distribution; report on jurisdictional authorities of state and local government related to centralized and decentralized alternative energy systems; federal-state conflicts and cooperation in the siting of nuclear energy facilities; the energy park experience in Pennsylvania; and a socio-economic institution summary of energy centers in Washington State. ERA

N78-19673# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
MAGNETIC CONFINEMENT FUSION ENERGY RESEARCH
H. Grad Mar. 1977 44 p refs Presented at the Ann. Meeting of the Am. Math. Soc., San Antonio, Jan. 1976
(Contract EY-76-C-02-3077)
(COO-3077-143; Conf-760158-1; MF-88) Avail: NTIS HC A03/MF A01

Controlled thermonuclear fusion offered a relatively clean energy solution with completely inexhaustible fuel and unlimited power capacity. The scientific and technological problem consisted in magnetically confining a hot, dense plasma for an appreciable fraction of a second. The scientific and mathematical problem was to describe the behavior, such as confinement, stability, flow, compression, heating, energy transfer and diffusion of this medium in the presence of electromagnetic fields. ERA

N78-19674# Los Alamos Scientific Lab., N. Mex.
PACER: SHORT CUT SOLUTION TO FUSION ENERGY PRODUCTION
1977 52 p ref
(Contract W-7405-eng-36)
(TID-27687) Avail: NTIS HC A04/MF A01

Proven hydrogen-weapon explosive technology was used to provide fusion power for the generation of electrical power, for the production of fissile material as fuel for light-water reactors, and perhaps for the production of gaseous hydrogen to extend our natural-gas resources. The PACER concept exploits the enormous amounts of energy released from a controlled fusion explosion that was safely contained within a large, steam-filled cavity. The energy was extracted from the steam and converted to electrical power by standard power-industry techniques. ERA

N78-19675# Minnesota Energy Agency, St. Paul.
ENERGY EMERGENCY CONSERVATION AND ALLOCATION PLAN
Jan. 1977 39 p
(PB-274492/8) Avail: NTIS HC A03/MF A01 CSCL 10A

In 1974 the Minnesota State Legislature directed that an Energy Emergency Conservation and Allocation Plan be prepared for use in the event of an energy supply emergency. The plan

is intended to establish priorities of energy usage and to provide conservation actions for reducing energy usage. This report discusses details of the plan. GRA

N78-19676# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
ENERGY DEMAND MODELING AND FORECASTING Final Report
W. Michael McHugh 1977 277 p refs Sponsored in part by Northwest Energy Policy Project, Portland, Ore., and Pacific Northwest Regional Commission, Vancouver, Wash.
(PB-274336/7) Avail: NTIS HC A13/MF A01 CSCL 10A

Results from an all energy econometric demand model were described and preserved. The model forecasts the demand for electricity, oil, natural gas, and coal for the Pacific Northwest as a whole, for the states of Idaho, Washington, and Oregon separately, and individually for seven distinct economic subregions therein. Individual forecasts were prepared for the residential, commercial, and industrial sectors and (by two-digit SIC code) transportation and irrigation. GRA

N78-19677# National Science Foundation, Washington, D. C.
RANN: RESEARCH APPLIED TO NATIONAL NEEDS. WIND ENERGY CONVERSION RESEARCH
Mar. 1977 23 p refs
(PB-271942/5; Bull-3-Rev-1; NSF/RA-770202) Avail: NTIS HC A02/MF A01 CSCL 10A

The NSF/RANN wind energy research reports listed are available for reading by the general public. Reports are indicated by RANN number, title, performing organization, author, date, grant number, abstract, descriptors, and availability. Also included is a list of 14 laboratory reports which address primarily the Darrieus vertical axis system and wind data. Author, title, report number, date, length, and price are indicated for each. Solar energy publications with wind energy sections also are indicated by title, performing organization, grant number, date and availability. GRA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N78-19678 Missouri Univ., Columbia.
EXAMINATION OF THE CONCENTRATION DISTRIBUTION OF SIX AIR POLLUTANTS BY MOBILE MONITORING Ph.D. Thesis
Ralph Maurice Keller, Jr. 1977 237 p
Avail: Univ. Microfilms Order No. 77-31735

Measurements of the concentrations of sulfur dioxide, nitric oxide, nitrogen dioxide, ozone, ammonia and carbon monoxide at ground level were acquired in the southern half of St. Louis, Missouri. The data were acquired during south, west, and northeast winds with the majority of the data acquired during the prevailing south winds. The concentrations were analyzed for repetitive patterns during similar weather conditions. With the patterns developed from the data, a method of locating stationary monitoring stations was developed and applied. Dissert. Abstr.

N78-19679 Northwestern Univ., Evanston, Ill.
DETECTION LIMITATIONS ON AIR POLLUTION MONITORING WITH STARK MODULATED MICROWAVE SPECTROSCOPY Ph.D. Thesis
Frank Morris Nigh 1977 173 p
Avail: Univ. Microfilms Order No. 77-32335

A general model using microwave molecular rotational resonances was developed to predict a minimum detectable pollutant concentration (MDC) for a polar molecule in a nitrogen atmosphere. With ammonia as a test pollutant concentrations of less than 10 parts per million were predicted and measured. The MDC was determined by molecular characteristics and instrument parameters. The maximum signal was obtained when sufficient microwave power was used to produce saturation of the resonant line. The sample pressure was increased to a value which was limited by the dielectric breakdown of the stark voltage modulating the resonant absorption. The minimum noise power was restricted by the integration time of the lock in amplifier which was on the order of the expected time interval between changes in the pollutant concentration. Dissert. Abstr.

N78-19680# Civil and Environmental Engineering Development Office, Tyndall AFB, Fla.
IMPACT OF SPACE SHUTTLE SUPPORT FACILITIES CONSTRUCTION ON SPECIAL INTEREST PLANT SPECIES (VANDENBERG AFB, CALIF.) Final Report, Jun. - Sep. 1977
R. C. Wooten, Jr., Dennis Strutz, and Ronald Hudson Sep. 1977 62 p refs
(AD-A049177; CEEDO-TR-77-33) Avail: NTIS HC A04/MF A01 CSCL 06/6

This report summarizes the results and conclusions of studies conducted to evaluate the impact of ground support facility construction for the space shuttle program at Vandenberg AFB, California on listed and proposed threatened or endangered plant species in order to comply with the Endangered Species Act of 1973. Vegetation surveys were made in proposed construction site areas. The listing used to determine threatened and endangered plant taxa were those plant species proposed as endangered or threatened in the 1975 Federal Register (40FR27824-27890) and those listed as endangered for rulemaking by the US Fish and Wildlife Service in the June 16, 1976 Federal Register (41FR24524-24572). The surveys also included other special interest taxa designated by the California Native Plant Society as being rare, endangered, or vascular plants of limited distribution in California. Three threatened species (Castilleja mollis, Monardella crispa, and Scrophularia atrata) and two endangered species (Cirsium rhothophilum and Erigeron foliosus var blochmanae) were found in a number of the construction site areas. It was determined that construction activities would not jeopardize the continued existence of any of these species. Mitigative measures were recommended to minimize adverse plant habitat modification or removal of any of these plants. Author (GRA)

N78-19681# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
AIRBORNE DETECTOR IMPROVEMENT
E. J. Schneid, F. R. Swanson, and A. Mendelsohn Mar. 1977 80 p refs
(Contract EX-76-C-13-1664)
(GJBX-40(77); RE-538) Avail: NTIS HC A05/MF A01

Experimental and theoretical comparisons were conducted between a large volume NaI detector and a large volume collimated Phoswich detector. Laboratory experiments were conducted to establish the ability of the existing Phoswich detector to provide background and Compton distribution suppression in the 1 to 3 MeV energy region of interest for this application. These measurements also served to verify the analytical models used for Phoswich detector design studies. The two detectors were flown to obtain simultaneous measurements of the potassium, uranium, and thorium concentrations in the vincinity of Lake Winnipesaukee, New Hampshire. The correlation of the flight results with the experimental and computer predictions supports the conclusion that a Phoswich detector system can provide approximately a factor of two increase in detection sensitivity. ERA

N78-19682# California Univ., Livermore. Lawrence Livermore Lab.
PARTICLE-IN-CELL VS STRAIGHT LINE GAUSSIAN CALCULATIONS FOR AN AREA OF COMPLEX TOPOGRAPHY
Rolf Lange and Christine Sherman 4 Mar. 1977 32 p refs Presented at Conf. on Appl. of Air Pollution Meteorology, Salt Lake City, Utah, Nov. 1977; sponsored by APCA and AMS
(Contract W-7405-eng-48)
(UCRL-79236; Conf-771118-1) Avail: NTIS HC A03/MF A01

Two numerical models for the calculation of time integrated air concentration and ground deposition of airborne radioactive effluent releases were compared. The time dependent Particle-in-Cell (PIC) model and the steady state Gaussian plume model were used for the simulation. The area selected for the comparison was the Hudson River Valley, New York. Input for the models

was synthesized from meteorological data gathered in previous studies by various investigators. It was found that the PIC model more closely simulated the three dimensional effects of meteorology and topography. Overall, the Gaussian model calculated higher concentrations under stable conditions. In addition, because of its consideration of exposure from the returning plume after flow reversal, the PIC model calculated air concentrations over larger areas than did the Gaussian model. ERA

N78-19683# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.
INSPECTION MANUAL FOR THE ENFORCEMENT OF NEW SOURCE PERFORMANCE STANDARDS: COAL PREPARATION PLANTS Final Report
Yatendra M. Shah and James R. Burke Washington EPA Nov. 1977 149 p refs
(Contract EPA-68-01-3150)
(PB-274262/5; EPA-340/1-77-022) Avail: NTIS HC A07/MF A01 CSCL 21D

Procedures for inspection of coal preparation facilities toward determination of their compliance with NSPS are presented. Background information to aid the inspector in understanding the coal preparation process and the effects of operating parameters on process emission is also given. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N78-19684 North Carolina State Univ., Raleigh.
SOME INHERENT LIMITATIONS TO THE ACCURACY OF D-REGION ELECTRON DENSITY PROFILES OBTAINED BY THE DIFFERENTIAL ABSORPTION PARTIAL REFLECTION TECHNIQUE Ph.D. Thesis
Harvey Nolan Turner, Jr. 1977 117 p
Avail: Univ. Microfilms Order No. 77-29676

D region electron density profiles were obtained by partial reflection techniques with some success, but there were times when the results appeared to be in error. Electron density profiles were obtained along with corresponding measurements of echo cone angle of arrival, mode isolation, and amplitude probability density. The results were compared so that sources of error in the profiles could be identified. Local minima in the electron density profiles around 80 km were related to the occurrence of wide angle oblique echoes. Altitude smearing caused by the oblique echoes introduced error into the measured ratios of extra-ordinary wave to ordinary wave backscattered powers and led, consequently, to the calculation of profiles with local minima. Shortened pulse lengths failed to yield improved altitude resolution because of the altitude smearing. Dissert. Abstr.

N78-19685 Clemson Univ., S.C.
NEWS THEOREMS Ph.D. Thesis
Daniel Wayne Welch 1977 94 p
Avail: Univ. Microfilms Order No. 77-29699

A closed form for the angular momentum news theorem for gravitational radiation was derived in physical spacetime along with the news theorems for energy and linear momentum. Naturally separated spin news and orbital news were found in the angular momentum news. No stress-energy tensor or series expansion of the metric was used. The assumptions used were not stronger than those used in the conformal rescaling derivation of these theorems. The approach used had electromagnetic analogues at all important stages of the calculations. The allowed transformations of the metric were developed. This produced the supertranslations and exposed an inherent uncertainty in the energy, momentum, and angular momentum of a radiating source. The transformation properties of the spin news and orbital news under the supertranslation corresponding to ordinary virtual displacement are presented. Dissert. Abstr.

N78-19686 California State Univ., San Diego.
OCEANIC CRUSTAL EVOLUTION: EVIDENCE FROM THE PETROLOGY AND GEOCHEMISTRY OF ISOLATED OCEANIC CENTRAL VOLCANOES Ph.D. Thesis
Rodey Batiza 1977 312 p
Avail: Univ. Microfilms Order No. 7732792

Analyses of basalts dredged in the vicinity of the East Pacific Rise at 9 deg N indicate that most samples were typical oceanic tholeiite. The wide range of tholeiite compositions observed is probably due to fractional crystallization of a high MgO parental tholeiite magma. This fractionation probably takes place in a crustal magma chamber below the axis of the rise. The chamber is apparently disrupted by the Siqueiros transform fault, as only high MgO tholeiites are found in the transform fault troughs. Alkalic basalts were recovered from a small volcano located near the intersection of the East Pacific Rise and the Siqueiros transform fault. The chemical and isotopic data from the East Pacific Rise, Isla Tortuga, Isla Guadalupe and other small volcanoes in the Pacific were consistent with the idea that the suboceanic mantle is heterogeneous on a relatively small scale. Dissert. Abstr.

N78-19687*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
DEFINITION OF ATMOSPHERIC SCIENCE EXPERIMENTS AND TECHNIQUES: WAKE ZONE MAPPING EXPERIMENTS Final Technical Report
David R. Taeusch Aug. 1976 21 p refs
(Contract NAS8-31772)
(NASA-CR-156697; Rept-014445-1-F) Avail: NTIS HC A02/MF A01 CSCL 04A

The development of a subsatellite system has been proposed for the shuttle program which would provide to the scientific community a platform for experiments which would be tethered to the shuttle spacecraft orbiting at about 200 km altitude. Experiments which can perform measurements of aeronomic interest onboard or utilizing the tethered satellite concept are described and recommended. Author

N78-19688*# Maryland Univ., College Park. Inst. for Physical Science and Technology.
ATMOSPHERIC LIDAR RESEARCH APPLYING TO H2O, O2 AND AEROSOLS Final Report
T. J. McIlrath and T. D. Wilkerson Dec. 1977 316 p refs
(Grant NsG-5062)
(NASA-CR-155798; BN-871) Avail: NTIS HC A14/MF A01 CSCL 04A

Experimental research on a near infrared tunable dye laser was reported, and theoretical simulations were presented for various lidar configurations. The visible and nearinfrared wavelengths considered were suitable for observations of aerosols, water vapor, molecular oxygen pressure and temperature in the troposphere and above. The first phase of development work was described on a ruby pumped, tunable dye laser for the wavelength region 715 to 740 nanometers. Lidar simulations were summarized for measurements of H2O and for two color lidar observations of aerosols in the atmosphere. Author

N78-19689*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF THE OZONE PROFILE FROM THE OUTGOING THERMAL EMISSION
Ye. P. Borisenkov, A. Ye. Kaygorodtsev, and O. M. Pokrovskiy Feb. 1978 23 p refs Transl. into ENGLISH from Meteorol. Gidrol. (USSR), no. 5, 1977 p 11-22 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75279) Avail: NTIS HC A02/MF A01 CSCL 04A

Problems of the information content of measuring the spectral and angular distribution of the outgoing thermal emission of the atmosphere-earth system in the 9.6 mm ozone absorption band are discussed. Two methods (nadir and limb) of remote measurement are considered. Information data obtained are evaluated according to three systems. Effectiveness of the regression interpretation method using the data of nadir and limb measurements is shown. Author

N78-19690# National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.
CLAY FABRIC AND GEOTECHNICAL PROPERTIES OF

SELECTED SUBMARINE SEDIMENT CORES FROM THE MISSISSIPPI DELTA

Richard H. Bennett, William R. Bryant (Texas A and M Univ., College Station), and George H. Keller (Oregon State Univ., Corvallis) Jul. 1977 97 p

(PB-275194/9; NOAA-PP-9) Avail: NTIS HC A05/MF A01 CSCL 08G

Results are reported of research on clay fabrics and selected geotechnical properties of submarine sediment samples--to core depths of 150 m--from the Mississippi prodelta depositional environment. The clay fabric of a Deep Sea Drilling Project sample is compared with the Delta samples because of its highly complex nature in the undisturbed versus the remolded states. Techniques of transmission electron microscopy, unique sample preparation, and quality control were used in the analyses. Three general areas of this investigation include: (1) a comprehensive literature review tracing the evolution of thought and development of concepts about clay fabrics; (2) a detailed study of analytical techniques, instrumentation, and sample quality as applied to clay fabrics; and (3) a study relating clay fabrics to selected geotechnical properties, depth of burial, and laboratory consolidated samples. Tentative clay fabric models related to predicted void ratios were proposed for submarine sediments. GRA

N78-19691# Purdue Univ., Lafayette, Ind. Dept. of Geosciences.

A TECTONIC OVERVIEW OF THE CENTRAL MIDCONTINENT

W. J. Hinze, L. W. Braile, G. R. Keller, and E. G. Lidiak Mar. 1977 117 p

(Contract AT(49-24)-0323)

(PB-275228/5) Avail: NTIS HC A06/MF A01 CSCL 08G

A summary is given of tectonics in the Central Midcontinent that will aid in geological, geophysical and seismological investigations of the area; and to design the optimum experiments and surveys to decipher the complex tectonics of the New Madrid area. The final section of this overview is a bibliography of the structure and tectonics of the area. The bibliography contains about 400 entries and is accessed from a computer file. A selective subject code has been devised so that the reference can be classified according to location, subject matter, and data provided. GRA

N78-19692# Avco-Everett Research Lab., Everett, Mass.

IR ATMOSPHERIC MEASUREMENTS Final Technical Report, 29 Jun. 1975 - 31 May 1977

H. P. Kent and P. F. Kellen Griffiss AFB, N.Y. RADC Nov. 1977 114 p refs

(Contract F30602-75-C-0235; ARPA Order 2646)

(AD-A049054; RADC-TR-77-385) Avail: NTIS HC A06/MF A01 CSCL 17/5

Apparent angle of arrival fluctuations for atmosphere-perturbed irradiance from bright astronomical sources was recorded with a view to determining refractive structure scaling with wavelength. Measurements were made with low spectral dispersion, 2.5 + or - lambda/delta lambda + or - 10, between 1.3 and 21 microns. Some results are presented. Random intensity scintillation observed in star and satellite LWIR signal records is apparently related to object size. The relation may be used to distinguish between point and extended objects of equal apparent brightness. Data review results are presented. The gross self-radiance of atmosphere may be measured to permit real-time computation of transmission. In circumstances where weather changes invalidate extinction measures, the technique offers promise of increasing credibility of conjectures made from observations of satellites. Preliminary results of tests are presented. Modifications to an existing LWIR radiometer permit long period signal averaging and enable the thermal signatures of deep-space satellites to be measured. Some results are presented.

Author (GRA)

N78-19693# Naval Research Lab., Washington, D. C.

LOW ALTITUDE PLASMA LINE ANISOTROPY Interim Report

Elaine S. Oran and Peter J. Palmadesso Oct. 1977 19 p

(AD-A049057; AD-E000086) Avail: NTIS HC A02/MF A01 CSCL 04/1

Plasma line observations obtained from incoherent radar backscatter have been used as a groundbased method for deriving information about the size and anisotropy of the ionospheric photoelectron fluxes. In the past data interpretation has been confined to altitudes above the F2 peak. Measurements below the F2 peak consistently show an anisotropy in the ratio of the downshifted to upshifted amplitudes of 20-50% when it is generally assumed that diffusion processes dominate. Calculations of the plasma line intensity are described which use a multi-angle multi-energy calculation of the photoelectron distribution function. The calculated electron flux exhibits a low altitude, low energy anisotropy which is reflected in the plasma line measurements. Given anisotropic elastic electron-neutral cross-sections, the flux anisotropy arises when the local mean free path is of the order of the local scale height. The net effect is conversion of a spatial density in homogeneity into a velocity distribution anisotropy. GRA

N78-19694# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Soils and Pavements Lab.

SUBSURFACE EXPLORATION IN ALLUVIAL TERRAIN BY SURFACE GEOPHYSICAL METHODS Final Report

William L. Murphy Dec. 1977 85 p refs

(AD-A049125; AEWES-MP-S-77-24) Avail: NTIS HC A05/MF A01 CSCL 08/11

Field tests were conducted at several sites in Louisiana to determine the effectiveness of two geophysical tools for detecting and locating subsurface geological features in alluvial terrain. The hammer seismic refraction technique, using a hammer source and portable seismograph, and the surface electrical resistivity method, using a d.c.-powered resistivity meter and current source, were investigated. Seismic refraction lines and resistivity soundings and profiles were run concurrently at each site. Boring control was used where available to aid in interpretation of the geophysical data. The resistivity profiling (fixed electrode spacing) technique was the most successful of the three methods, detecting or locating the targeted geologic feature at three of the four sites tested. The resistivity sounding (expanding electrode spacing) technique delineated shallow features but was ineffective at depth. The hammer seismic technique also achieved only limited success at depth, attributed primarily to attenuation of the seismic signals by loose near-surface materials. Surveys were precluded at one site by the presence of certain man-made features that interfered with the collection of usable data. GRA

N78-19695# Naval Research Lab., Washington, D. C. Optical Radiation Branch.

ATMOSPHERIC TRANSMISSION MEASUREMENT PROGRAM AND FIELD TEST PLAN Interim Report

James A. Dowling, Richard F. Horton, Gary L. Trusty, Thomas H. Cosden, Kenneth M. Haught, Joseph A. Curcio, Charles O. Gott, Steven T. Hanley, Peter B. Ulrich, and W. L. Agambar (Potomac Research, Inc., McLean, Va.) 30 Nov. 1977 90 p refs

(AD-A049186; AD-E000081; NRL-8059) Avail: NTIS HC A05/MF A01 CSCL 04/1

An atmospheric measurement program combining laser-line-extinction, Fourier-spectroscopy, and gas-filter-correlation-spectrometer experiments is described. A brief summary of the NRL experimental propagation effort since 1970 is presented followed by an abbreviated discussion of the current status of linear propagation modeling. Objectives of the current NRL atmospheric transmission program are stated. An experimental field test plan is presented followed by detailed information contained in several appendixes concerning procedures and facilities for laser-line-extinction measurements and calibrations, scanning-Michelson-interferometer experiments, gas-filter-correlation-spectrometer measurements, meteorological and aerosol data acquisition, and on-site data processing. Information concerning project staffing and a schedule for preparation and performance of a field experiment to be carried out at the Patuxent Naval Air Station, Patuxent River, Md., are contained in two final appendixes. Author (GRA)

N78-19696# Naval Research Lab., Washington, D. C.

COLLISIONLESS EFFECTS ON THE SPECTRUM OF SECONDARY AURORAL ELECTRONS AT LOW ALTITUDES Interim Report

K. Papadopoulos and H. L. Rowland Oct. 1977 23 p refs

(AD-A049115; AD-E000059; NRL-MR-3637) Avail: NTIS HC A02/MF A01 CSCL 04/1

It is shown by use of particle computer simulations that collisionless interactions, due to energetic electron precipitation in the auroral zones, can be responsible for the break from the E-3 dependence of the secondary electron spectrum expected on the basis of collisional models, even at very low altitudes (-180 km). Author (GRA)

N78-19697# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

THE SEMIANNUAL VARIATION IN THE UPPER ATMOSPHERE (900-1200 km) AT SOLAR MINIMUM Technical Report, 1974 - 1976

A. Eisner and S. M. Yionoulis Sep. 1977 38 p refs
(Contract N00017-72-C-4401)
(AD-A048851; APL/JHU-TG-1314) Avail: NTIS HC A03/MF A01 CSCL 04/1

A new method has been developed that uses satellite along-track position errors to obtain information on atmospheric densities at altitudes of 900 to 1200 km. The data base used was the daily tracking results from the Navy Navigation Satellite System (NNSS). Densities derived from these data (for the years 1974-76) show a pronounced semiannual variation, with the April/October maxima exceeding the August/January minima by factors of 2 to 4. The variation is more pronounced than was previously reported, and double the best current modeled variation. The current resolution with this technique is estimated to be 1 x 10 to the -19th power gm/cu cm, or about 10% of the total density at these altitudes. Author (GRA)

N78-19698# Army Electronics Command, White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

IONOSPHERIC D-REGION ELECTRON DENSITY DATA AVAILABILITY

Robert Rubio Nov. 1977 16 p refs
(AD-A049275; ECOM-DR-77-6) Avail: NTIS HC A02/MF A01 CSCL 20/14

A survey of the availability of ionospheric D-region electron density data has been completed and is reported here. A table which lists 45 world locations where lower ionospheric electron density profiles have been obtained is included. The availability of electron density data is interpreted in terms of the general global distribution and in terms of both intermediate and long-path high frequency (3 to 30 MHz) Army communications channels. World maps are also included which serve to illustrate localities where D-region data have been recorded and world sections and paths where high frequency communications channels are currently active. Author (GRA)

N78-19699# Liege Univ. (Belgium).

HIGH RESOLUTION TRANSMISSION MEASUREMENTS OF THE ATMOSPHERE IN THE INFRARED Scientific Report, 1 Mar. 1976 - 28 Feb. 1977

Marcel V. Migeotte and R. Zander 31 May 1977 18 p
(Contract AF-AFOSR-2985-76)
(AD-A049205; AFGL-TR-77-0172) Avail: NTIS HC A02/MF A01 CSCL 03/1

Summary of stratosphere-related results and new solar line identifications, deduced from 1974 and 1976 balloon observations in the infrared. Author (GRA)

N78-19700# Teledyne Micronetics, San Diego, Calif.

ADAPTIVE TROPOSPHERIC RANGE CORRECTION Final Report, Nov. 1976 - Aug. 1977

Steven Weisbrod, Lee A. Morgan, and Philip A. Hicks Sep. 1977 79 p refs
(Contract F30602-76-C-0384)
(AD-A049282; R22-77; RADC-TR-77-326) Avail: NTIS HC A05/MF A01 CSCL 17/9

This report describes a technique for obtaining accurate adaptive range correction for very low elevation angles utilizing radar as a sensor. A two step procedure is utilized. First, the radar obtains refractive bending information from tracking cooperative targets whose angular positions and range are accurately known. This information is thus used to estimate the range correction for uncooperative targets. The technique consists of defining the range delay as a sum of three terms of which the first term involves integration over the refractive profile, whereas, the other two terms are expressable in terms of parameters directly measured by the radar. It also turns out that the integral of the first term can be accurately evaluated using a 'standard profile' determined by the radar. This technique was evaluated using 96 radiosonde profiles. Maximum range error estimates were about 1.5 meters with typical values of less than 50 cm. Author (GRA)

N78-19701# Teledyne Geotechnical, Alexandria, Va.

SPECIAL DATA COLLECTION SYSTEM (SDCS) EVENT REPORT, NOVAYA ZEMLYA, SSR, 29 SEPTEMBER 1976

M. S. Dawkins and M. D. Gillispie 23 Nov. 1977 13 p refs
(Contract F08606-78-C-0007; ARPA Order 2551)
(AD-A049291; SDCS-ER-76-116) Avail: NTIS HC A02/MF A01 CSCL 17/10

This event report contains seismic data from the Special Data Collection System (SDCS), and other sources for the above event. GRA

N78-19702# Air Force Geophysics Lab., Hanscom AFB, Mass.

A NEW AUTOMATIC PROCESSING TECHNIQUE FOR SATELLITE IMAGERY ANALYSIS, AIR FORCE SURVEYS IN GEOPHYSICS

R. S. Hawkins 3 Aug. 1977 67 p refs
(AD-A049350; AFGL-TR-77-0174; AFGL-AFSC-371) Avail: NTIS HC A04/MF A01 CSCL 09/4

A new approach to the analysis of satellite imagery is presented. The central part of this approach is an algorithm which compresses information stored in the ordinary six or eight bits per picture element into only one bit. The quality of this compression is demonstrated by examples of its application to high resolution visual imagery. Both visual inspection and rms difference criterion are used for this evaluation. There are four objectives of this report which are: to review the status of processing techniques which remove redundant information, to show the need for redundance reduction in the processing of satellite images, to present the development of an algorithm for reducing it, and to show results obtained by application of the algorithm to visual imagery. Also, comments are made on needed developments of the technique and its potential application to problems of analysis of satellite imagery data. Author (GRA)

N78-19703# Mission Research Corp., Santa Barbara, Calif.

AURORAL SIMULATION EFFECTS Final Report, 1 Nov. 1975 - 31 Mar. 1977

Douglas H. Archer and Paul W. Tamm 31 Mar. 1977 37 p refs
(Contract DNA001-76-C-0138)
(AD-A049066; AD-E300039; MRC-R-313; DNA-HAES-62; DNA-4275F) Avail: NTIS HC A03/MF A01 CSCL 04/1

This report describes the continuing and concluding work related to analyses of ICECAP data with emphasis on short wavelength infrared radiation in the auroral environment. A brief description of some satellite-communications related work is also included. Data from two auroral events, taken by ICECAP rockets IC 519.07-B and IC 507.11-2A, were analyzed and compared with results from computer calculations. These comparisons, along with those from earlier studies, are used to draw conclusions and recommendations related to IR modeling in the nuclear environment. A new and more accurate procedure for calculating electron temperatures was devised and incorporated into the auroral code ARCTIC. The results were used, along with ion mass spectrometer measurements in an aurora, to infer enhanced values for the NO concentration. Author (GRA)

N78-19704# Army Electronics Command, Fort Monmouth, N. J.

STRATOSPHERIC COMPOSITION BALLOON-BORNE EXPERIMENT, 23-26 SEPTEMBER 1975

Harold N. Ballard and Frank P. Hudson Oct. 1977 131 p refs
(AD-A049030; ECOM-5830) Avail: NTIS HC A07/MF A01 CSCL 04/1

Within the period September 1968 to September 1975, six balloon-borne experiments were conducted under the title of 'Stratospheric Composition Stratcom Experiments.' The initial experiments September 1968 and September 1969 were designed

to measure the temperature variation near an altitude of 50 km that were to be associated with the diurnal stratospheric tide. Requirements by the Department of Defense for information concerning stratospheric composition, as well as measurements of national interest to the possible pollution of the stratosphere by the Super Sonic Transport and by chlorofluorocarbons, gradually increased the number, types, and complexity of measurements conducted during each successive experiment. This composite report presents, in one publication, the related results obtained from the various experiments comprising the STRATCOM VI-A and VI-B payloads as determined by the various experimenters. The results, coupled with the ECON Report 'Correlation of Selected Atmospheric Composition Parameters for the Mid-Latitude September Stratosphere,' are representative of the correlated multi-instrument approach of the STRATCOM Program to the experimental study of the stratosphere, backed by chemical kinetic theory and atmospheric modeling. GRA

N78-19705# Airborne Research Associates, Weston, Mass.
APPLICATION AT ATMOSPHERIC ELECTRICAL INSTRUMENTATION FOR DETECTION OF AEROSOL PLUMES AND ATMOSPHERIC STRUCTURE Final Report
Ralph Markson Dec. 1977 36 p refs Presented at the Ann. Program Rev., Naval Air Systems Command, AIR 310C on Energy Conversion, Monterey, Calif., 8-10 Nov. 1977
(Contract N000 19-77-C-0372)
(AD-A049083) Avail: NTIS HC A03/MF A01 CSCL 04/1

This report summarizes work done under Contract N00019-77-C-0372 for the Naval Air Systems Command. The basic objective has been to compare in-situ measurements of aerosol plumes with atmospheric electrical records in order to evaluate the potential of the latter. Initial efforts involved securing and installing an integrating nephelometer (Meteorology Research Inc. Model 1550B) in the Bellanca atmospheric research aircraft. The nephelometer is sensitive to aerosols in the 0.1 to 2 micrometers diameter size range. In general there are three peaks in the distribution of atmospheric aerosols; (1) The 'Course' Mode; mechanically generated particles such as dust in the 5 to 10 micrometers size range, (2) The 'accumulation' mode: typically formed by combustion processes, these grow to 0.5 to 1.0 micrometers and are optimally sized for measurement with a light scattering device such as the integrating nephelometer, (3) The 'fresh' mode: also formed from combustion, these are in the 0.01 to 0.1 micrometers size range. They grow rapidly by coagulation and agglomeration into the accumulation mode typically in a few minutes up to a maximum of 20 minutes. GRA

N78-19706# Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
RETRIEVAL OF BALLISTIC DENSITIES AND LAYER THICKNESSES FROM SATELLITE RADIANCE OBSERVATIONS Final Technical Report, Oct. 1975 - Jun. 1977
George Ohring, Eliram Broida, and Dina Goldberg Jun. 1977 28 p refs
(Grant DA-ERO-124-74-G0057)
(AD-A047098) Avail: NTIS HC A03/MF A01 CSCL 04/2

The general objective of this work is to develop and evaluate techniques for determining atmospheric parameters in meteorologically 'silent' areas from satellite radiance observations. A non-statistical method for obtaining ballistic densities directly from satellite radiance observations is derived. The method takes advantage of the fact that both the ballistic density and the satellite radiances depend upon weighted vertical integrals of the atmospheric temperature. Tests of this method on realistically simulated radiances indicate root-mean-square retrieval errors of 1/4 to 1/3 of the standard deviation of ballistic density for individual months. The method thus appears to be suitable for application to areas of the globe with a paucity of conventional radiosonde observations. Fleming's direct inversion method for retrieving layer thicknesses is evaluated on a set of realistically simulated satellite radiances. Results indicate that there is no significant advantage to be gained by using the previous day's temperature profile rather than a monthly mean temperature profile for the geographical area as the standard profile required by the method. This result, together with the relatively low retrieval errors obtained with the method, suggest that it would be appropriate for use in meteorologically silent areas. GRA

N78-19707# California Univ., Livermore. Lawrence Livermore Lab.
OVERVIEW OF THE RELATIONS EARTHQUAKE SOURCE PARAMETERS AND THE SPECIFICATION OF STRONG GROUND MOTION FOR DESIGN PURPOSES
D. L. Bernreuter Aug. 1977 54 p refs Presented at 2d Meeting of the Group of Experts on Reference Ground Motions in Nucl. Safety Assessments, Rome, 14 Oct. 1977
(Contract W-7405-eng-48)
(UCRL-79982; Conf-771026-1) Avail: NTIS HC A04/MF A01

One of the steps in the seismic design process was the specification of the appropriate ground motion to be input into the design analysis. The important parameters were peak ground acceleration, spectral shape and peak spectral levels. Ground displacement was a useful parameter. The earthquake was usually specified by giving its magnitude and either the epicentral distance or the distance of the closest point on the causitive fault to the site. The appropriate ground motion parameters were obtained using the specified magnitude and distance in equations obtained from regression analysis among the appropriate variables. ERA

N78-19708# Illinois Benedictine Coll., Lisle.
MEASUREMENT OF ATMOSPHERIC ALPHA ACTIVITY
J. J. Spokas 1977 22 p Presented at the Joint Meeting of the North Central and Midwest Chapters of the AAPM, Lake Geneva, Wis., 7 May 1977
(Contract EY-76-S-02-0323)
(COO-323-38; Conf-770591-1) Avail: NTIS HC A02/MF A01

Results of two studies, one based on daily measurements over a period of approximately 5.5 weeks and the other measurements over a period of 62 days led to the conclusion that the ground-level atmospheric alpha activity was subject to variations of at least an order of magnitude. Possibly significant correlations were found between atmospheric alpha activity and temperature and humidity. The activity in stagnant air was one to two orders of magnitude greater than the average found outdoors. Radon-222 and its daughters would seem to account essentially for the entire alpha activity in the atmosphere. The atmospheric alpha activity was measured absolutely with an ionization chamber coupled to a sensitive electrometer. ERA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N78-19709 Texas A&M Univ., College Station.
FORECASTING THUNDERSTORMS OVER A 2- TO 5-h PERIOD BY STATISTICAL METHODS Ph.D. Thesis
Joseph Allen Zak 1977 128 p
Avail: Univ. Microfilms Order No. 77-32220

Classical statistical techniques, such as multiple regression with variable selection and principal component analysis, were employed to define combinations of parameters from meteorological observations which optimally discriminate between the occurrence and nonoccurrence of thunderstorms. Routine observations of weather elements at five levels in the troposphere during two spring and summer seasons were analyzed objectively onto a 65-km grid which spanned much of the central United States. A thunderstorm occurrence was defined from manually digitized radar (MDR) observations with an MDR code of four or greater as the basis. This technique can be applied rapidly and effectively in an operational environment at locations within the developmental area. It offers all the advantages of an objective forecast and contains no disadvantages from being tied to specific forecast models. Dissert. Abstr.

N78-19710*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC REMOTE INSTRUMENT APPLICATIONS: ASSESSMENT OF THE NEAR-TERM MARKET

Louis Rosenblum, Larry R. Scudder, William A. Poley, and William J. Bifano Dec. 1977 19 p refs
(Contract E(49-26)-1022)
(NASA-TM-73881; DOE/NASA/1022-77/24; E-9492) Avail: NTIS HC A02/MF A01 CSCL 14B

A preliminary assessment of the near term market for photovoltaic remote instrument applications is presented. Among the potential users, two market sectors are considered: government and private. However, the majority of the remote systems studied are operated by or for the federal, state, or local governments. Environmental monitoring and surveillance remote instrument systems are discussed. Based on information obtained in this preliminary market survey, a domestic, civilian market of at least 1.3 MW sub pk is forecast for remote instrument systems. This estimate is exclusive of several potentially large scale markets for remote instruments which are identified but for which no hard data is available. Author

N78-19711*# Tennessee Univ. Space Inst., Tullahoma.
PROCEEDINGS OF THE FIRST ANNUAL METEOROLOGICAL AND ENVIRONMENTAL INPUTS TO AVIATION SYSTEMS WORKSHOP
Dennis W. Camp, ed. and Walter Frost, ed. Mar. 1977 335 p refs Workshop held at Tullahoma, Tenn., 8-10 Mar. 1977; sponsored by NASA, NOAA, and FAA
(Contract NAS8-29584)
(NASA-CP-2028; FAA-RD-77-173) Avail: NTIS HC A15/MF A01 CSCL 04B

The proceedings of a workshop of many disciplines of the aviation community are presented. The general topics addressed were general, services, aircraft design, simulation, and general aviation. For individual titles, see N78-19712 through N78-19729.

N78-19712* Tennessee Univ. Space Inst., Tullahoma. Atmospheric Science Div.
METEOROLOGICAL AND ENVIRONMENTAL INPUTS TO AVIATION SYSTEMS: OPENING REMARKS
Walter Frost *In its* Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 2-14 (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04A

Opening remarks for the workshop are given. A description of the workshop and a schedule of the committee meetings are presented. Tables of suggested questions for discussion and lists of the individual participants for the various committees are also presented. G.Y.

N78-19713* Alden Electronic and Impulse Recording Equipment Co., Washington, D. C.
AVIATION WEATHER SERVICE REQUIREMENTS, 1980 - 1990
Newton A. Lieurance *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 18-26 (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04B

Future aviation weather needs are discussed. Priority weather requirements and deficiencies existing for weather observations and forecast services in terminal areas are presented. Needs in en route operations up to 30 km are addressed with emphasis on turbulence, presence of suspended ice and water particles, SST to supersonic speeds, solar radiation, ozone, and sonic booms. Some conclusions are drawn and recommendations are presented. G.Y.

N78-19714* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OVERVIEW OF NASA/MARSHALL SPACE FLIGHT CENTER'S PROGRAM ON KNOWLEDGE OF ATMOSPHERIC PROCESSES
Dennis W. Camp *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 28-40 refs (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04A

The Marshall Space Flight Center (MSFC) is charged with the responsibility to enhance aviation safety through improving understanding of various atmospheric phenomena. A brief discussion is presented concerning the tasks and work being accomplished by MSFC. The tasks are defined as follows: (1) to determine and define the turbulence and steady wind environments induced by buildings, towers, hills, trees, etc., (2) to identify, develop, and apply natural environment technology for the reconstruction and/or simulation of the natural environment for aircraft accident investigation and hazard identification, (3) to develop basic information about free atmosphere perturbations, (4) to develop and apply fog modification mathematical models to assess candidate fog modification schemes and to develop appropriate instrumentation to aquire basic data about fog. To accomplish these tasks MSFC has developed a program involving field data acquisition, wind tunnel studies, theoretical studies, data analysis, and flight simulation studies. Author

N78-19715* National Oceanic and Atmospheric Administration, Rockville, Md.
AN OVERVIEW OF AVIATION WEATHER SERVICES
John W. Connolly *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 41-48 (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04B

Safety of flight is the first concern of the aviation weather service, the economics of air transportation is a second major interest. Weather is a significant causal factor impacting on the efficiency of air transportation. A discussion is presented on the functions of various weather service agencies as they relate to one another in the dissemination of information to the pilot and to the air traffic controller. Improvements in the aviation weather service and weather knowledge are cited as future goals. The weather service at the present time is an efficient system but future aviation objectives dictate more improvements are needed (especially in automation technology) to enhance flight planning and for safe and efficient flight execution. G.Y.

N78-19716* National Weather Service, Silver Spring, Md.
THE AUTOMATION OF FIELD OPERATIONS AND SERVICES (AFOS) WITHIN THE NWS AND ITS IMPACT ON AVIATION METEOROLOGY
Edward M. Gross *In* Tennessee Univ. Space Inst. Proc. of The 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 49-57 (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04B

Future program efforts in Automation of Field Operations and Services (AFOS) are presented. The AFOS concept involves extensive use of minicomputers, video display, and rapid communication to aid field personnel in their daily activities. Some of the predominant characteristics of AFOS are: (1) communications will be consolidated and streamlined, (2) the system is modular in structure, (3) it is not subject to catastrophic failure, (4) it can be implemented in phases adaptable to changing conditions and requirements. Aviation forecast products now available and future products are discussed. G.Y.

N78-19717* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRPLANE DESIGN FOR GUSTS
John C. Houbolt *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 58-71 refs (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 01C

There are two basic approaches used for the structural design of aircraft due to dust encounter. One is a discrete gust approach, the other is based on power spectral techniques. Both of these approaches are explained in this report. Tacit to the above approaches is the assumption that loading on the airplane arises primarily from vertical gusts. A study of atmospheric turbulence was made not only on the vertical component, but on the longitudinal and transverse gust components as well. An analysis was made to establish the loads that develop when explicit consideration is given to both the vertical and head-wind components. The results are reported. Also included in this report are brief comments on gust effects during approach and landing. G.Y.

N78-19718* Federal Aviation Administration, Washington, D. C.
A SYNOPSIS OF THE WEATHER PROBLEMS FACING TODAY'S GENERAL AVIATION PILOTS
James C. Pope *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 72-82 (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04B

Concentration on weather to data has primarily been at the point of observation. There have been efforts to obtain and disseminate en route weather through pilot reports (PIREPS), but the efforts have been meager. What is needed is the cooperative efforts on the application of technology to the acquisition and dissemination of the en route weather data for those pilots in the air as well as those who are flight planning on the ground. A comprehensive three-dimensional computer storage system is proposed that receives weather information from all aircraft on IFR flight plans and stores this information by altitude and geographic coordinates. Also, a report on the Federal Aviation Administration's Research Engineering and Development Aviation Weather Program from the aspect of past, present and future is given. G.Y.

N78-19719* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NASA'S AVIATION SAFETY RESEARCH AND TECHNOLOGY PROGRAM
George H. Fichtl *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 83-102 refs (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 01B

Aviation safety is challenged by the practical necessity of compromising inherent factors of design, environment, and operation. If accidents are to be avoided these factors must be controlled to a degree not often required by other transport modes. The operational problems which challenge safety seem to occur most often in the interfaces within and between the design, the environment, and operations where mismatches occur due to ignorance or lack of sufficient understanding of these interactions. Under this report the following topics are summarized: (1) The nature of operating problems, (2) NASA aviation safety research, (3) clear air turbulence characterization and prediction, (4) CAT detection, (5) Measurement of Atmospheric Turbulence (MAT) Program, (6) Lightning, (7) Thunderstorm gust fronts, (8) Aircraft ground operating problems, (9) Aircraft fire technology, (10) Crashworthiness research, (11) Aircraft wake vortex hazard research, and (12) Aviation safety reporting system. Author

N78-19720* Tennessee Univ. Space Inst., Tullahoma.
UTSI ATMOSPHERIC SCIENCE PROGRAM
Walter Frost *In its* Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 103-140 refs (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04A

Two areas of research were carried out concerned with meteorological and environmental inputs to aviation systems. One effort dealt with the investigation of wind fields about bluff geometries typical of buildings or other man made obstructions to the surface wind and the behavior of craft flying through these disturbed wind fields. The second effort was the definition and mathematical models of atmospheric wind shear associated with thunderstorms, stable boundary layers, and synoptic fronts. These mathematical models can be utilized in flight simulators to train pilots and flight crews and to develop instrumentation for landing in adverse wind shear conditions. Author

N78-19721* Federal Aviation Administration, Washington, D. C.
THE MULTI-DIMENSIONAL NATURE OF WIND SHEAR INVESTIGATIONS
William J. Cox *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshops Mar. 1977 p 141-174 refs (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04B

The impact of air carrier accidents has lead to investigations into the wind shear phenomenon. This report includes such topics as wind shear characterization, aircraft pilot performance in shear conditions, terminology and language development, wind shear forecasting, ground and flight wind shear displays, wind shear data collection and dissemination, and pilot factors associated with wind shear encounters. Some areas which show promise for short term solutions to the wind shear hazards includes: (1) improved gust front warning through ground based sensors; (2) greater pilot awareness of wind shear through improved training; and (3) airborne displays based on groundspeed/airspeed comparisons. J.C.S.

N78-19722* Airline Pilots Association, Denison, Tex.
PROBLEMS PILOTS FACE INVOLVING WIND SHEAR
W. W. Melvin *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 175-187 refs (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 04B

Educating pilots and the aviation industry about wind shears presents a major problem associated with this meteorological phenomenon. The pilot's second most pressing problem is the need for a language to discuss wind shear encounters with other pilots so that the reaction of the aircraft to the wind shear encounter can be accurately described. Another problem is the flight director which gives a centered pitch command for a given angular displacement from the glide slope. It was suggested that they should instead be called flight path command and should not center unless the aircraft is actually correcting to the flight path. J.C.S.

N78-19723* Boeing Aerospace Co., Seattle, Wash.
WIND MODELS FOR FLIGHT SIMULATOR CERTIFICATION OF LANDING AND APPROACH GUIDANCE AND CONTROL SYSTEMS
Dwight R. Schaeffer *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 188-274 refs (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 17G

The definition of a model suitable for certification was the main objective of this report. The model was designed to simplify and reduce the wind model parameters to enable evaluation of a large number of aircraft and control system design parameters. Analytical descriptions of wind phenomena were presented. For those parameters defying analytic description, probabilistic descriptions were sought. A brief analysis of the effects of wind on aircraft motion was conducted. The axes transformations required between wind and turbulence components in their inherent axis system and in the airplane's axis system were shown. Techniques of providing a random process on computers for the representation of turbulence were presented. A simulation model was presented that combines all the foregoing components. J.C.S.

N78-19724* Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
SUMMARY REPORT OF THE AIRCRAFT DESIGN COMMITTEE
Robert J. Woodcock *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 275-284 (For availability see N78-19711 10-47)
Avail: NTIS HC A15/MF A01 CSCL 01C

Meetings were held concerning aircraft design with considerable interest shown in aircraft operations. Topics covered were: (1) structural design for turbulence; (2) flight control; (3) data needs; and (4) lightning. Other factors discussed were temperature, rain, hail, icing, pressure, density, corrosives, and abrasives. J.C.S.

N78-19725* Federal Aviation Administration, Washington, D. C.
SUMMARY REPORT OF THE GENERAL SERVICES COMMITTEE
John H. Enders *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 285-290 (For availability see N78-19711 10-47)

Avail: NTIS HC A15/MF A01 CSCL 04B

The discussions addressed meteorological services in terms of: (1) assessment of adequacies of present services; (2) acquisition and processing of data not now available, but deemed vital to improvement of the aviation system; and (3) delivery of an adequate meteorological service to various users within the National Aviation System, yet responsive to changing system requirements. Other discussions included meteorological information, training and personnel, and research needs and responsibilities. J.C.S.

N78-19726* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SUMMARY REPORT OF THE SIMULATION COMMITTEE

Richard L. Kurkowski *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 291-303 (For availability see N78-19711 10-47)

Avail: NTIS HC A15/MF A01 CSCL 14B

Topics discussed by the simulation committee included: (1) simulators and their uses; (2) atmospheric disturbance modeling requirements; (3) Status of simulators' capabilities for modeling disturbances; and (4) status of atmospheric disturbance models. Also discussed were specific problem areas; simulation studies criteria, aircraft/atmospheric disturbance response modeling and pilot learning effects. J.C.S.

N78-19727* Aircraft Owners and Pilots Association, Bethesda, Md.

SUMMARY REPORT OF THE GENERAL AVIATION COMMITTEE

Wallace C. Goodrich *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshops Mar. 1977 p 304-308 refs (For availability see N78-19711 10-47)

Avail: NTIS HC A15/MF A01 CSCL 04B

Fatal weather involved general aviation accidents and the criteria for weather observations at general aviation airports were discussed. It was generally agreed that: (1) meteorologists do not seem to have sufficient understanding of general aviation requirements, (2) pilots are not aware of the meteorological services and publications which are available to them; (3) Uniform capability is not being utilized to the degree possible; and (4) there is a wealth of weather data available within the Department of Defense which is not available in the system for civil use. The committee recommends that student pilot training programs include actual inflight weather experience accomplished through instructor training, and efforts be made to make real time weather data available to the pilot from all sources to include military installations, Unicom operators, tower and approach controllers, and air traffic controllers. J.C.S.

N78-19728* National Weather Service, Silver Spring, Md.

SUMMARY REPORT OF COMMITTEE A

Charles H. Sprinkle *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 309-313 (For availability see N78-19711 10-47)

Avail: NTIS HC A15/MF A01 CSCL 01C

Sessions were held with the standing committees on aircraft design, simulation, general services, and general aviation. It was stated that current procedures for designing structural components with respect to turbulence forcing functions were adequate. It was agreed that the ultimate goal of aviation weather services was the delivery of accurate and timely information to the cockpit flight crew. J.C.S.

N78-19729* National Center for Atmospheric Research, Boulder, Colo.

SUMMARY REPORT OF COMMITTEE B c47

Donald H. Lenschow *In* Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop Mar. 1977 p 314-320 (For availability see N78-19711 10-42)

Avail: NTIS HC A15/MF A01 CSCL 01C

Topics discussed in this summary include: (1) general aviation and services; (2) aircraft design; and (3) simulation. It was concluded that private pilots need to be more knowledgeable about weather. Improvement is needed in providing general aviation pilots with changes in the weather reporting and forecasting systems. There should also be some simulation of various severe shear profiles in training simulators, although there is still a problem in simulating shear conditions using mathematical models and data. J.C.S.

N78-19730*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

GROUND WINDS AND WINDS ALOFT FOR EDWARDS AFB, CALIFORNIA (1978 REVISION)

D. L. Johnson and S. C. Brown Mar. 1978 284 p refs

(NASA-TM-78160) Avail: NTIS HC A13/MF A01 CSCL 04B

Ground level runway wind statistics for the Edwards AFB, California area are presented. Crosswind, headwind, tailwind, and headwind reversal percentage frequencies are given with respect to month and hour for the two major Edwards AFB runways. Also presented are Edwards AFB bivariate normal wind statistics for a 90 degree flight azimuth for altitudes 0 through 27 km. Wind probability distributions and statistics for any rotation of axes can be computed from the five given parameters. Author

N78-19731*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE NIMBUS 6 DATA CATALOG. VOLUME 10: 1 JANUARY - 28 FEBRUARY 1977, DATA ORBITS 7620-8409

Dec. 1977 289 p refs Prepared in cooperation with Management and Tech. Serv. Co., Beltsville, Md.

(NASA-TM-79371) Avail: NTIS HC A13/MF A01 CSCL 04B

Operations of various experiments during the reporting period are summarized. Orbital elements, data availability times, anomalies in the data, geographic location, and time of data are tabulated. Montages obtained by infrared and microwave radiometers are included. Author

N78-19732# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

COMPARISON OF DEVELOPING VS. NON-DEVELOPING TROPICAL DISTURBANCES

Steven L. Erickson Jul. 1977 90 p refs

(Contract DAEA18-76-C-0050)

(AD-A048641; CSU-ATSP-274) Avail: NTIS HC A05/MF A01 CSCL 04/2

Developing and non-developing western North Pacific tropical disturbances are investigated and compared utilizing Defense Meteorological Satellite Program (DMSP) and rawinsonde data. Quantitative measurements of deep convection and cirrus amounts from the satellite visual and infrared data indicate that no large deep-convective difference exists between these two classes of disturbances. In addition, the daily variability of deep convection was determined to be large in both the developing and non-developing disturbances. Implications are that the amount and intensity of deep convection is not well related to disturbance tropical storm genesis potential. Genesis appears to be related to the special positioning of the deep convection and surrounding wind fields. When genesis occurs, the deep convection appears to act indirectly to warm the tropical disturbance by means of dynamically forced subsidence. Documentation is provided to support this hypothesis. Author (GRA)

N78-19733# Naval Postgraduate School, Monterey, Calif.

THE HISTORY, OPERATION AND PERFORMANCE OF AN EXPERIMENTAL AUTOMATIC WEATHER STATION IN ANTARCTICA Technical Report, Apr. - Jun. 1977

Robert J. Renard and Manuel G. Salinas Oct. 1977 58 p refs

(Grant NSF DDP-76-00437)

(AD-A048410; NPS-63RD77101) Avail: NTIS HC A04/MF A01 CSCL 04/2

The paper describes the prototype Automatic Weather Station platform (AWS), developed at Stanford University, and presents an evaluation of the data produced by its temperature, pressure and wind sensors while the platform was deployed at three locations on Antarctica (South Pole, McMurdo and Marble Point) during the years 1975-77. The major purpose of the Antarctica test was to monitor the durability of the platform

and its sensors and electronics, under harsh climate conditions. Instrument redundancy was employed for the measurement of pressure and wind. Data transmission from the sensors was effected by the Nimbus 6 Random Access Measurement System (RAMS). The evaluation is represented by a statistical analysis of the deviations of AWS readings from official observations at South Pole and McMurdo, as appropriate. These indicate that the pressure transducers functioned well throughout the period while temperature and wind sensors malfunctioned at various times. Deviations for most instruments exceeded those of the manufacturer's stated accuracies. GRA

N78-19734# Dugway Proving Ground, Utah.
TURBULENCE MEASUREMENTS ON A FORTY-EIGHT METER TOWER IN DESERT TERRAIN Data Report, 14 Feb. - 8 Apr. 1977
Albert W. Waldron, Jr. Oct. 1977 445 p refs
(AD-A049036) Avail: NTIS MF A01 CSCL 04/2

This is a data report for which turbulence, wind and temperature profiles were collected on a 48 m tower for 10 minute periods every data collection hour. Net radiation measurements were made and averaged for half hour periods every hour. Salt Lake City rawinsondes were collected at 0500 and 1700 hours local time. Dugway West Vertical Grid morning rawinsondes and afternoon 10 gram pilot balloon soundings were collected daily. The tower and net radiometer data were collected at Dugway West Vertical Grid every successful data collection hour of the day between 0900 Monday and 1500 Friday for an 8 week period, February 14 through April 8, 1977. All tower data were smoothed. Both observed and smoothed data are reproduced. Calculation of stability parameters; Richardson's number, Monin-Obukhov length scale and bulk Richardson's number are prepared for four layers. Friction velocity is calculated for the lowest three layers. Power law exponents are calculated for wind speed and turbulence. Approximately 50 percent of the data are associated with 8 m wind speeds of 3 m/s or more and are suitable for classical profile analysis. Known universal methods of data analysis are presented. Pasquill stability categories for these data are tabulated. Author (GRA)

N78-19735# Saint Louis Univ., Mo. Dept. of Earth and Atmospheric Sciences.
CLIMATIC MODELS THAT WILL PROVIDE TIMELY MISSION SUCCESS INDICATORS FOR PLANNING AND SUPPORTING WEATHER SENSITIVE OPERATIONS Scientific Report, 20 Oct. 1976 - 20 Oct. 1977
Donald E. Martin and Eloise Myers 20 Oct. 1977 36 p refs
(Contract F19628-77-C-0032)
(AD-A048888; AFGL-TR-77-0258; SR-1) Avail: NTIS HC A03/MF A01 CSCL 04/2

Analytic formulae are presented for modelling climatic mission success indicators for joint ceiling and visibility categories from a knowledge of the separate unconditional probabilities for these two parameters for the same location with zero time lag. Analytic formulations are similarly presented which extend the modelling capabilities to incorporate considerations of time differentials and distance separations. A method is presented for compacting the RUSSWO statistics for ceilings and visibilities (by a factor of approximately 1 to 100) for ready manual or computer reference. Author (GRA)

N78-19736# Denver Univ., Colo. Dept. of Physics.
BALLOON-BORNE ION SAMPLING PACKAGE Final Report, 15 Apr. 1974 - 14 Apr. 1976 and 23 Apr. 1976 - 22 Oct. 1977
J. R. Olson, R. C. Amme, J. N. Brooks, D. A. Steffen, R. E. Sturm, and D. G. Murcray 14 Dec. 1977 29 p refs
(Grants DAHC04-74-G-0149; DAAG29-76-G-0211)
(AD-A049194; ARO-12239.1-GS) Avail: NTIS HC A03/MF A01 CSCL 01/3

A mass filter package for atmospheric sampling in the stratosphere has been designed and constructed so that ambient positive ions can be detected in one mode of operation (PI) and ambient negative ions in a second mode of operation (NI). The range of the quadrupole mass filter is 1-150 amu. Any one of the 150 mass positions can be selected for a fixed peak operation, or the total range can be covered in a continuous sweep at the rate of 300 amu per second. Filtered ions are individually counted. The atmosphere is sampled through a valved 0.03 diameter orifice which has a conductance of about 9(10 to 3rd power) liters/sec and width-to-thickness ratio greater than 10. Ambient temperature, ambient pressure, atmospheric electrical conductivity and cosmic ray ionization detectors are also part of the package. An on-board clock and logic circuitry control the gathering of data. However, the mass filter operations can also be preferentially controlled via telemetry. Data are concurrently recorded with an on-board digital tape recorder and telemetered to earth for real time data analysis. The entire package has been designed and constructed to minimize contamination of the atmosphere being sampled. Preliminary results from a recent flight show evidence for the presence of hydrated protons in the stratosphere. Author (GRA)

N78-19737# Battelle Pacific Northwest Labs., Richland, Wash.
RAINFALL ENHANCEMENT DUE TO SCAVENGING OF COOLING TOWER CONDENSATE
M. T. Dana and M. A. Wolf Sep. 1977 52 p refs
(Contract EY-76-C-06-1830)
(BNWL-2295) Avail: NTIS HC A04/MF A01

Estimates of rainfall enhancement resulting from scavenging of cooling tower condensate droplets were made using relevant aerosol scavenging theory and a range of meteorological conditions. For a large natural-draft tower, releasing 170,000 g/sec of condensate, plume centerline rainfall enhancement was predicted to be measurably high at down wind distances between 100 m and 1 km for moderate wind speeds and rainfall rates. The cumulative removal of condensate by scavenging should be significant, even in a light rain, where removal half-distances were predicted to be 2.5, 10, and 20 km for wind speeds of 1, 5, and 10 m/sec, respectively. ERA

N78-19738# National Oceanic and Atmospheric Administration, Princeton, N. J. Geophysical Fluid Dynamics Lab.
THE INTERANNUAL VARIABILITY OF ATMOSPHERIC CIRCULATION STATISTICS
Abraham H. Oort Oct. 1977 81 p refs
(PB-275196/4; NOAA-PP-8; NOAA-77110407) Avail: NTIS HC A05/MF A01 CSCL 04B

The year to year variability of various zonal mean general circulation parameters was described. The parameters studied include the wind components, temperature, geopotential height, and specific humidity, as well as their variances in time and space and their meridional and vertical transports. The main body of the report consists of tables and graphs of interannual standard deviations computed for the different calendar months as a function of latitude and pressure. Author

N78-19739# Denver Research Inst., Colo. Cloud Physics Lab.
DEVELOPMENT OF ORGANIC ICE NUCLEI GENERATORS FOR WEATHER MODIFICATION, VOLUME 1 Final Report
Norihiko Fukuta, Myron N. Plooster, James A. Armstrong, Arpad Gorove, James R. Butz, Robert C. Schaller, and Lester Glen Jun. 1977 144 p refs
(Grant NSF ENV-73-02910)
(PB-274952/1; NSF/RA-770136-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 04B

The development of prototypes of ground and airborne organic smoke generators is addressed. The center of the program reported here involves the development of three kinds of organic ice nuclei generators. Two supporting studies, one on the performance of supersonic nozzles to optimize the nozzle design, and the other on ice nucleation mechanisms of organic smoke particles using a new thermal diffusion chamber, are also discussed. Also, a prototype generator tested in cumulus clouds in South Dakota showed encouraging effects of seeding. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N78-19740*# Oregon State Univ Corvallis. Dept. of General Science.

ASSESSMENT OF THE IMPACT OF INCREASED SOLAR ULTRAVIOLET RADIATION UPON MARINE ECOSYSTEMS Annual Progress Report, 8 Oct. 1976 - 8 Dec. 1977
Henry Vandyke Dec. 1977 72 p refs
(Contract NAS9-14860)
(NASA-CR-151648) Avail: NTIS HC A04/MF A01 CSCL 08A

Specifically, the study has addressed the following: (1) potential for irreversible damage to the productivity, structure and/or functioning of a model estuarine ecosystem by increased UV-B radiation or ecosystems highly stable or amenable to adaptive change, and (2) the sensitivity of key community components (the primary producers, consumers, and decomposers) to increased UV-B radiation. Three areas of study were examined during the past year: (1) a continuation of the study utilizing the two seminatural ecosystem chambers, (2) a pilot study utilizing three flow-through ecosystem tanks enclosed in a small, outdoor greenhouse, and (3) sensitivity studies of representative primary producers and consumers. Author

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N78-19741 Agricultural and Technical Coll. of North Carolina, Greensboro.
REGULATION OF MAMMALIAN HIBERNATION Ph.D. Thesis
John Thomas Burns 1977 83 p
Avail: Univ. Microfilms Order No. 77-28662

Neural and endocrine mechanisms were investigated with regard to the regulation of hibernation. Hibernation was inhibited with injections of alloxan, p-chlorophenylalanine, and two different temporal relationships of corticosterone and prolactin. Prolactin injections given 20 hours after daily injections of corticosterone for 11 days during the hibernation season prevented hibernation. Prolactin given 12 hours after corticosterone markedly reduced the occurrence of hibernation. This effect indicated that a temporal synergism of corticosterone and prolactin may be part of a circannual mechanism that regulates seasonal physiological and behavioral changes. The role of neurotransmitters in the neural control of hibernation was tested. Dissert. Abstr.

N78-19742*# Texas A&M Univ., College Station.
[LOCOMOTOR BEHAVIOR OF FISH HATCHED FROM EMBRYOS EXPOSED TO FLIGHT CONDITIONS] Final Report
H. Kleerekoper 13 Feb. 1978 3 p
(Contract NAS9-15175)
(NASA-CR-151633) Avail: NTIS HC A02/MF A01 CSCL 06C

Embryos of Fundulus heteroclitus in various stages of development were exposed to space flight conditions aboard Apollo spacecraft and Cosmos satellites. The objective of the study was to ascertain whether fish hatched from these embryos displayed locomotor behavior different from that of control fish of the same age. An electronic monitoring technique was used to record behavior. Results indicate no change in locomotor behavior in fish on Apollo Spacecraft, but inexplicable significant changes were noted in fish aboard Cosmos Satellites. Author

N78-19743# Civil Aeromedical Inst., Oklahoma City, Okla.
FUNCTIONAL LOCALIZATION IN THE NUCLEUS ROTUNDUS
Alvin M. Revzin Oct. 1977 14 p refs
(AD-A047717/4; FAA-AM-77-22) Avail: NTIS HC A02/MF A01 CSCL 06/15

It was suggested that the effects of psychoactive drugs on visual performance may best be understood, and/or predicted, by studying differential effects of the drugs on functionally differentiated sets of neurons in visual projection systems in the brain. It was demonstrated that the nucleus rotundus, an avian posterior thalamic visual relay nucleus homologous to parts of the mammalian lateralis posterior/pulvinar complex, is divided into at least three functionally distinct neuron subsets. The posterior rotundal cells respond to any moving retinal image. Ventral rotundal cells respond preferentially to intensity modulation of moving or stationary stimuli. Anterior rotundal neurons respond preferentially to such abstract properties of moving stimuli as size, velocity, and direction of movement. All subnuclei may be further subdivided by function. The findings reinforce current theories which suggest that pattern vision results from cortical integration of the outputs of many classes of pattern selective visual projection system neurons. Author

N78-19744# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
TEMPERATURE INFLUENCES ON GROWTH OF AQUATIC ORGANISMS
C. C. Coutant and J. S. Suffern 1977 13 p refs Presented at the Conf. on Waste Heat Management and Util., Miami Beach, Fla., 9 May 1977
(Contract W-7405-eng-26)
(CONF-770516-9) Avail: NTIS HC A02/MF A01

Temperature profoundly affects the growth rates of aquatic organisms, and its control is essential for effective aquaculture. Characteristically, both low and high temperatures produce slow growth rates and inefficient food conversion, while intermediate temperature ranges provide rapid growth and efficient food conversion. Distinct, species-specific optimum temperatures and upper and lower temperatures of zero growth can often be defined. Thermal effects can be greatly modified by amounts and quality of food. These data not only provide the basis for criteria which maintain growth of wild organisms but also for effectively using waste heat to create optimal conditions of temperature and food ration for growing aquatic organisms commercially. ERA

N78-19745# Johns Hopkins Univ., Baltimore, Md.
MOLECULAR BASIS FOR THE MUTAGENIC AND LETHAL EFFECTS OF ULTRAVIOLET IRRADIATION
1977 8 p refs
(Contract EY-76-S-02-2814)
(TID-27764) Avail: NTIS HC A02/MF A01

Pathways of DNA repair in bacteria and mammalian cells were examined. Progress is reported on the following studies: genetic control of incision and excision in Escherichia coli; effects of binding proteins on the repair process in vitro; location of endonuclease - UV-irradiated DNA complexes; identification of eukaryotic repair mechanisms; nuclear complementation in HeLa cells; enzyme isolation from repair syndrome skin fibroblasts; and expression of the E. coli - SV40 hybrid DNA. ERA

N78-19746# Pennsylvania State Univ., University Park. Dept. of Biochemistry and Biophysics.
BASIC ASPECTS OF RADIATION ACTION ON MICROORGANISMS Progress Report, 1 Apr. 1976 - 30 Jun. 1977
E. C. Pollard Jul. 1977 23 p
(Contract EY-76-S-02-2362)
(COO-2362-26) Avail: NTIS HC A02/MF A01

Ultraviolet mutagenesis follows a relation, part of which is an induction process, very similar to the induction process for induced radioresistance and induced inhibition of postirradiation DNA degradation. The repair of single-strand breaks produced by gamma rays takes place more rapidly than does postirradiation DNA degradation. Repaired DNA is degraded and there is good repair of single-strand breaks in lex cells followed by degradation of the repaired DNA. The signal for the start of radiation-induced DNA degradation is probably not single-strand breaks. The dose-response relation for the lambda induction requires more dose and has kinetics different from those for the induction of other phenomena. No evidence of induced radioresistance in two lambda lysogens of E. coli was found. There is induced radioresistance if the lysogens are of induction-minus phage. ERA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N78-19747 Ohio State Univ., Columbus.
AN AUTOMATED SACCADE ANALYSIS SYSTEM Ph.D. Thesis
James Robert Brown 1977 221 p
Avail: Univ. Microfilms Order No. 77-31837

A computer based eyetracking system was developed to automatically analyze human saccadic eye movement responses to two dimensional step deflections of a visual target. Subject eye rotation was monitored with a modified Cornsweet-Crane eyetracker whose electrical outputs, representing horizontal and vertical eye rotations, were sampled, digitized, and stored by a PDP-8/E computer for later analysis. Software analysis of subject eye responses to step target deflections yields first saccade latency time and eye settling times to within various radii of the final target position. Nearly 400 responses from each of 4 subjects were recorded and analysed; stimuli consisted of target deflections generated at random angles and with both fixed and random magnitudes. Out of 4 subjects tested, 3 demonstrated heretofore unreported latency increases for downward target deflections. Dissert. Abstr.

N78-19748 California Univ., Berkeley.
ROTATING DISC INDUCED HEMOLYSIS AS INFLUENCED BY DISC MATERIAL AND BLOOD CHEMISTRY Ph.D. Thesis
Richard Dulin Offeman 1977 359 p
Avail: Univ. Microfilms Order No. 77-31483

A rotating disc apparatus was employed to compare 22 materials to each other by means of the amount of hemolysis each generated during a standard shearing test. Since bloods from different donors vary in the shape and magnitude of their kinetic hemolysis curves, as does a single blood tested at different storage ages, it was necessary to provide a common reference material, polyethylene, to which materials run on different bloods could be compared. Time independent ranking of the hemolytic behavior of these materials relative to polyethylene was accomplished. The average relative magnitude of hemolysis generated by a polymeric material was found to correlate with its critical surface tension, with a low critical surface tension material generating low hemolysis. Dissert. Abstr.

N78-19749 Yale Univ., New Haven, Conn.
BRAIN MONOAMINES AND TEMPERATURE REGULATION Ph.D. Thesis
Mao-Tsun Lin 1977 117 p
Avail: Univ. Microfilms Order No. 77-28148

Thermoregulatory responses to a variety of thermal stresses were examined in groups of rabbits treated by intracerebroventricular injections of either 6-hydroxydopamine (6-OHDA) or 5 7-dihydroxytryptamine (5,7-DHT). The thermal stresses chosen were: changes in ambient temperature, changes in hypothalamic temperature, and febrile responses to the pyrogenic agent prostaglandin E. It was found that both 6-OHDA treated and 5,7-DHT treated animals were capable of maintaining their internal body temperatures within normal limits over a wide range of ambient temperatures. Both groups of animals retained their preoptic anterior hypothalamic thermosensitivity and they both responded to pyrogenic challenges, although in an attenuated fashion. However, specific alterations in the thermoeffector outputs were noted in both groups of animals. Dissert. Abstr.

N78-19750# Virginia Univ., Charlottesville.
RETINAL ROD OUTER SEGMENT DISCS: A STUDY OF MEMBRANE STRUCTURE AND FUNCTION Ph.D. Thesis
Henry Gilbert Smith, Jr. 1977 138 p
Avail: Univ. Microfilms Order No. 77-28612

Osmotically intact discs were prepared from retinal rod outer segments by osmotic shock followed by flotation. The flotation effectively separated osmotically intact discs from protein contaminants, burst discs, and other membranous debris. The high purity of this preparation was further supported by polyacrylamide gel electrophoresis. The integrity of the discs was confirmed by electron microscopy and by their osmotic behavior. The lipid structure of discs was studied with the nonmembrane penetrating labeling reagent, trinitrobenzenesulfonate. When present outside of the discs this reagent reacted with all of the phosphatidylethanolamine and phosphatidylserine in the membrane. It was concluded that the disc had a markedly asymmetric membrane with these lipids distributed preferentially in the outer surface. Dissert. Abstr.

N78-19751*# National Aeronautics and Space Administration, Washington, D. C.
THE RATE OF SYNTHESIS AND DECOMPOSITION OF TISSUE PROTEINS IN HYPOKINESIA AND INCREASED MUSCULAR ACTIVITY
I. V. Fedorov, A. V. Chernyy, and A. I. Fedorov Feb. 1978 10 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (USSR), v. 63, no. 8, 1977 p 1128-1133 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Med. Inst., Yaroslavl (USSR), v. 63, no. 8, 1977 p 1128-1133
(NASA-TM-75203) Avail: NTIS HC A02/MF A01 CSCL 06S

During hypokinesia and physical loading (swimming) of rats, the radioactivity of skeletal muscle, liver, kidney, heart, and blood proteins was determined after administration of radioactive amino acids. Tissue protein synthesis decreased during hypokinesia, and decomposition increased. Both synthesis and decomposition increased during physical loading, but anabolic processes predominated in the total tissue balance. The weights of the animals decreased in hypokinesia and increased during increased muscle activity. Author

N78-19752*# National Aeronautics and Space Administration, Washington, D. C.
RESEARCH REPORT ON THE PHYSIOLOGICAL EFFECTS OF AIR IONS AND THEIR SIGNIFICANCE AS ENVIRONMENTAL FACTORS
Andras Varga Feb. 1978 37 p refs Transl. into ENGLISH from Forschungsbericht ueber die Physiol. Wirkung. von Luftionen und deren Bedeutung als Umweltfaktoren, 1972 p 1-28 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original Doc. prep. by Heidelberg Univ., West Germany
(Contract NASw-2791)
(NASA-TM-75086) Avail: NTIS HC A03/MF A01 CSCL 06P

The series of experiments performed have shown that small air ions generated artificially using radioactive materials produced physiological effects in all test subjects, which are described. These results show that the air ions were important climatic factors in the production of comfortable and healthy room climates. Author

N78-19753# Miami Univ., Oxford, Ohio. Dept. of Psychology.
RESEARCH ON VISUAL PERCEPTION OF COMPLEX AND DYNAMIC IMAGERY Final Technical Report, Sep. 1975 - Aug. 1977
Allan J. Pantle Wright-Patterson AFB, Ohio AMRL Nov. 1977 127 p refs
(Contract F33615-76-C-5006)
(AD-A049127; AMRL-TR-77-83) Avail: NTIS HC A07/MF A01 CSCL 06/4

This report discusses three main research topics, each of which is interpreted in terms of a spatial frequency analysis model of the human visual system. Parameters which affect the perception of clusters of line elements in dynamic, computer-generated displays are investigated. Transitions between perception of the moving cluster as a group and perception of the motion of the individual elements of the cluster are studied as a function of display frame rate, subject dark adaptation, image contrast, spatial orientation and various positional perturbations of elements in the cluster. The effect of spatial frequency components on eye movement in real-life scenes was studied by correlating eye movement patterns obtained from photographic scenes which were spatially high-pass filtered, low-pass filtered, or unfiltered. Results indicate that areas of scenes containing strong low spatial frequency components attract attention more than areas containing strong high spatial frequency components. Velocity coding in the human visual system was studied by means of moving sinusoidal gratings. Results with complex moving gratings indicate that velocity perception depends partially on the temporal variation of intensity at each point on the retina due to the moving pattern. A complex pattern containing a fundamental spatial frequency and higher harmonic components appear to be moving faster than a stimulus consisting of only

the fundamental component and moving at the same velocity as the complex pattern. GRA

N78-19754# Massachusetts General Hospital, Boston.
NEW IMAGING SYSTEMS IN NUCLEAR MEDICINE Technical Progress Report, 1 Oct. 1976 - 31 May 1977
G. L. Brownell 1977 43 p
(Contract EY-76-S-02-3333)
(COO-3333-30) Avail: NTIS HC A03/MF A01

Work carried out on the development of instrumentation and techniques for positron scintigraphy is discussed. Progress in positron imaging instrumentation and applications is detailed. The assembly and initial evaluation of the multicrystal positron camera, PC-2, was completed. Images were obtained in both two and three dimensions which demonstrate the basic physical properties of the instrument. Sucessful measurements using transverse section imaging were carried out on animals and human volunteers. Physiological investigation using PC-2 is proceeding. A flexible and accurate computer program was developed for transverse section reconstruction of data acquired by PC-2. This program makes it possible to reconstruct both the activity distribution and the distribution of absorption. The program was developed to handle variations in the data collection procedure. ERA

N78-19755# Washington Univ., Seattle. Bioelectromagnetics Research Lab.
RF RADIATION ABSORPTION PATTERNS: HUMAN AND ANIMAL MODELING DATA
Arthur W. Guy, Michael D. Webb, and John A. McDougall Sep. 1977 79 p refs Prepared for School of Aerospace Med., Brooks AFB, Tex.
(Contract NIOSH-IA-75-30)
(PB-274749/1; DHEW/PUB/NIOSH-77/183) Avail: NTIS HC A05/MF A01 CSCL 06R

Various models of animals and humans were exposed to radiofrequency fields and power absorption patterns and the rates of power absorption at specific anatomical locations within the models were thermographically recorded under simulated industrial exposure conditions. The results of the modeling research demonstrate the validity of this technique for predicting the magnitude and distribution of radiofrequency power absorption in humans and animals. The utility of the techniques for extrapolation to human radiofrequency exposure thresholds from animal data was firmly established. GRA

N78-19756# Joint Publications Research Service, Arlington, Va.
SPACE BIOLOGY AND AEROSPACE MEDICINE, NO. 1, 1978
O. G. Gazenko, ed. 9 Mar. 1978 145 p refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 145 p
(JPRS-70753) Copyright. Avail: Issuing Activity

Articles are presented concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights; research aimed at guaranteeing safety on long flights and reliability of the human component of the 'man-spaceship' system; space psychology and physiology; environmental problems; control and telemetry. For individual titles, see N78-19757 through N78-19767.

N78-19757# Joint Publications Research Service, Arlington, Va.
METHODS OF STUDYING INFLIGHT PILOT PERFORMANCE
N. I. Frolov *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 1-12 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 3-11 (For availability see N78-19756 10-52)
Copyright. Avail: Issuing Activity

Aspects of pilot performance evaluation were generally discussed, with references to recent publications in which efforts were made to analyze human performance. A definition of pilot performance was offered as his capacity to perform flight assignments with a specified level of efficiency in the course of his flight shift, in the presence of sufficient motivation, training and adequate physical condition. Psychological and physiological responses of pilots were also discussed. B.L.P.

N78-19758# Joint Publications Research Service, Arlington, Va.
PROVISIONS FOR RADIATION SAFETY OF THE CREW OF THE SECOND EXPEDITION ON SALYUT-4
S. I. Avdyushin, Ye. Ye. Kovalev, V. M. Petrov, N. K. Pereyaslova, A. V. Sedov, L. G. Smolenskiy, A. P. Tibanov, and V. I. Shumshurov *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 13-20 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 11-17 (For availability see N78-19756 10-52)
Copyright. Avail: Issuing Activity

Aerospace radiation environments were considered in regard to spacecrew safety. The earth's radiation belts were examined and safety assessments for elliptically orbiting spacecraft were made. Individual radiation doses to crew members of Soyuz spacecraft and Salyut, as well as equipment for monitoring radiation situations in spacecraft, were provided in tabular form. B.L.P.

N78-19759# Joint Publications Research Service, Arlington, Va.
COMBINED EFFECT OF WEIGHTLESS AND IONIZING RADIATION OF RATS: RESULTS OF MORPHOLOGICAL STUDIES
V. V. Portugalov and Ye. A. Savina *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 21-27 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 17-22 (For availability see N78-19756 10-52)
Avail: Issuing Activity

Results of morphological studies conducted on rats exposed to radiation on Kosmos-690 satellite are discussed, in order to demonstrate the distinctions of the combined effect of weightlessness and penetrating radiation. Analysis of the changes demonstrated was made in three main direction: (1) how weightlessness affects the course of radiation lesions; (2) how radiation affects changes caused by weightlessness; (3) is there summation of effects due to each of these factors when used in combination. It was found that changes were induced by weightlessness and the aggregate of all factors of space flight. All of the organs and systems of the organism did not react similarly to these factors. Morphologically discernable changes were found in the skeletomuscular system, lymphoid organs, hemopoietic system, as well as systems involved in adaptation reactions: hypothalamo-hypophyseoadrenal and reninangiotensin-juxtaglomerular system of the kidneys. In conclusion, there are target organs in the animal's body that react first to weightlessness. Author

N78-19760# Joint Publications Research Service, Arlington, Va.
ISOZYME COMPOSITION OF LACTATE DEHYDROGENASE OF RAT SKELETAL MUSCLES AFTER FLIGHT IN KOSMOS-690 BIOSATELLITE
N. V. Petrova *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 28-33 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 23-27 (For availability see N78-19756 10-52)
Avail: Issuing Activity

Studies were made of isozyme composition of lactate dehydrogenase (LDH), one of the enzymes of carbohydrate metabolism, in the soleus and plantaris muscles of rats after a 20.5 day flight in the Kosmos-690 biosatellite. The effects of radiation and weightlessness were of major interest. Electrophoresis in polyacrylamide gel was used to study the isozyme spectrum of LDH of skeletal muscles. Reliability of the obtained results was determined by the method of variation statistics. Results indicate that the changes in proportion of isozyme fractions of LDH on the 2nd day after the flight, are due to the effects of weightlessness; subsequent changes in correlation between LDH fraction activity are related to the effects of radiation. Author

N78-19761# Joint Publications Research Service, Arlington, Va.
EFFECTS OF SPACE FLIGHTS AND CONCOMITANT

RADIATION ON AMINO ACID METABOLISM IN RAT SKELETAL MUSCLES

A. S. Ushakov, M. S. Gayevskaya, T. F. Vlasova, N. A. Veresotskaya, and Ye. B. Miroshnikova *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 34-38 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 27-31 (For availability see N78-19756 10-52)

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The results of studying the amino acid pool and transaminase activity in the femoral quadriceps of rats exposed to radiation during a flight in the Kosmos-690 biosatellite are presented. The femoral quadriceps was taken from rats 1 and 26 days after completion of a 20.5-day flight in space and ground-based control experiments. In the flight and ground-based experiments, the animals were exposed to doses of 220, 670 and 955 rad radiation. Free amino acids of the rat femoral quadriceps were assayed on an automatic analyzer, using ion-exchange chromatography with prior deproteinization of specimens with sulfosalicyclic acid. Activity of aspartate aminotransferase, and alanine aminotransferase, as well as protein content, were determined in the fraction of sarcoplasmic proteins. A comparison of all data led to the conclusion that irradiation of rats during space flight resulted in marked impairment of metabolism of aspartic acid, phenylalamine, methionine, glutamic acid and serine in skeletal muscles. Author

N78-19762# Joint Publications Research Service, Arlington, Va.

SENSORY COMPONENTS OF OPTICOKINETIC NYSTAGMUS UNDER THE INFLUENCE OF ANGULAR ACCELERATIONS

V. I. Babiyak *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 87-92 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 66-71 (For availability see N78-19756 10-52)

Copyright. Avail: Issuing Activity

Oculomotor reactions and their psychophysiological components, which are formed as mandatory and purposeful mechanisms of control in the case of exposure of the operator to a combination of visual and vestibular stimuli were investigated. Studies dealt with the patterns of perception of opticokinetic stimuli (OKS) and determination of the relationship between objective OKN indices and these stimuli under the combined effect of vestibular stimuli and angular accelerations. Analysis of angular rate of OKN slow components (SC) as a function of OKS revealed that the index of angular velocity of OKN SC is different in different individuals, with increase in angular velocity of OKS. In some, it remained relatively high with all gradations of OKS velocity, and in others it was significantly diminished. It was found that there was a number of individuals with an intermediate level for this index. Author

N78-19763# Joint Publications Research Service, Arlington, Va.

A DEVICE FOR MEASUREMENT OF RATE OF SLOW PHASE OF NYSTAGMUS ON THE NYSTAGMOGRAM

V. N. Krutko *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 93-95 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 72-73 (For availability see N78-19756 10-52)

Copyright. Avail: Issuing Activity

A device was developed which permitted processing of nystagmograms recorded at any paper-feeding rate and calibrations encountered in nystagmographic practice in a single operation of superposition of the nystagmic curve over a path on the scale. Author

N78-19764# Joint Publications Research Service, Arlington, Va.

AN AUTOMATED SYSTEM FOR EVALUATION OF EYE FATIGUE

V. F. Ananin and V. A. Filin *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 96-99 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 73-75 (For availability see N78-19756 10-52)

Copyright. Avail: Issuing Activity

The set of equipment developed for early detection of eye fatigue consisted of instruments for determining acuity of vision, recording eye movements, accommodation, pupillary reaction and blinking reflex, an attachment to record oculomotor coordination, instruments for recording intraocular pressure and calibrometry of vessels from films of the fundus and an electroencephalograph. The instrument for recording micromovements of the eyes was based on the photoelectron principle. Author

N78-19765# Joint Publications Research Service, Arlington, Va.

THE ROLE OF SKELETAL MUSCLE TONE IN REGULATION OF ORTHOSTATIC CIRCULATION

V. Ye. Katkov and L. I. Kakurin *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 100-105 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 75-78 (For availability see N78-19756 10-52)

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Relaxation of muscles had a significant effect on the orthostatic reaction. This was manifested by an increase in extent of pressure drop in the aorta, decrease in and slowing of development of pressure reaction, elimination of increase in blood flow in the aorta and rise of pressure in the right atrium. This indicated that the changes in the orthostatic position during the experiment, caused changes in skeletal muscle tone which created conditions for improving venous influx of blood to the heart and restoration of aortic pressure. Author

N78-19766# Joint Publications Research Service, Arlington, Va..

OXYGEN CONTENT OF BLOOD DURING PROLONGED ROCKING

L. A. Radkevich *In its* Space Biol. and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 106-109 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 78-80 (For availability see N78-19756 10-52)

Copyright. Avail: Issuing Activity

Results indicate that in the case of prolonged vestibular stimulation while breathing atmospheric air, rabbits, representative of the animal type that was resistant to vestibular stimuli, did not develop serious disturbances of oxygenation of blood. The observed changes were consistent and were compensated by psychoiogical mechanisms. Author

N78-19767# Joint Publications Research Service, Arlington, Va.

RESISTANCE TO HYPERBARIC OXYGENATION AND FACTORS AFFECTING IT

V. P. Dudarev *In its* Space and Aerospace Med., No. 1, 1978 (JPRS-70753) 9 Mar. 1978 p 113-117 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), no. 1, 1978 p 81-83 (For availability see N78-19756 10-52)

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Methods and modes of oxygen therapy and oxygen prophylaxis, and the physiological and biochemical processes that provide for relative stability of the internal environment of the organism in the presence of an altered gas environment were studied. The resistance of rats on the basis of survival of intact, thyroidectomized or adrenalectomized rats to high oxygen pressure (HOP) of 3 and 5 atm(gage) and resistance of mice according to survival of intact and splenectomized animals was evaluated. The adrenal function of rats according to ascorbic acid level of the adrenals was assayed after exposure to HOP. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N78-19768# Civil Aeromedical Inst., Oklahoma City, Okla.

DISORIENTATION TRAINING IN FAA-CERTIFICATED FLIGHT AND GROUND SCHOOLS: A SURVEY

William E. Collins, A. Howard Hasbrook, Amelia O. Lennon, and Dorothy J. Gay Sep. 1977 15 p refs

(AD-A047718/2; FAA-AM-77-24) Avail: NTIS HC A02/MF A01 CSCL 05/9

A voluntary questionnaire answered by 674 flight and ground schools provided information on (1) the conduct of formal instruction about disorientation; (2) the occurrence and content of lectures on disorientation; (3) use of on-the-ground demonstrations of disorientation; (4) use of in-the-air demonstrations of disorientation; (5) use of films on pilot vertigo; (6) amount of instrument flying training students receive; (7) amount of instrument flying training required of flight instructors to maintain their proficiency; (8) adequacy of the school's program on disorientation training; (9) other comments, and (10) numerical data regarding the number of students beginning and completing various flight and/or ground school courses. More than one-third of the respondents evaluated their disorientation training program as inadequate and defined the inadequacy most often as a lack of appropriate materials, aids, and information. Author

N78-19769# National Aviation Facilities Experimental Center, Atlantic City, N. J.

SIMULATOR PILOT CONSOLES FOR NAS ENROUTE AND ARTS 3 FACILITIES Final Report, Jun. 1976 - May 1977

Kenneth House, Stephen Karovic, and Theodore Rundall Nov. 1977 101 p

(FAA Proj. 216-103-100)

(AD-A047567/3; FAA-NA-77-36; FAA-RD-77-136) Avail: NTIS HC A06/MF A01 CSCL 05/9

The work effort and results of a feasibility and desirability study of replacing simulator pilot consoles in the field with more cost effective, easier to learn and use devices are described. A touch panel input device using a menu list concept with target to map association, performed by an interface processor, was recommended. As an aid to deciding the desirability of proceeding with such a procurement, the costs of various alternatives were estimated. The costs of the preferred system was found to exceed the budget, unless a reduced number of consoles or sites were equipped, in which case the average cost per console was increased substantially. Author

N78-19770# Arizona State Univ., Tempe. Dept. of Psychology.

COGNITIVE PRETRAINING: AN AID IN THE TRANSITION FROM INSTRUMENT FLYING Final Report

John V. Crosby Williams AFB, Ariz. AFHRL Oct. 1977 45 p refs

(Contract F41609-75-C-0018)

(AD-A048816; AFHRL-TR-77-62) Avail: NTIS HC A03/MF A01 CSCL 05/9

This study was designed to investigate the role of cognitive pretraining relative to the early difficulties encountered by student pilots transitioning from ground-based instrument training to composite flying training. The cognitive pretraining consisted of: (a) an instrument reading review, (b) a vocabulary of relevant cockpit features, (c) the use of brief perceptual rules for pitch and bank attitudes, and (d) prototype representations of a variety of pitch and bank attitudes. Three groups of 12 pilots each participated in the study: student experimental, student control, and experienced instructor pilots (IP). The experimental group was exposed to cognitive pretraining and then compared to the student control and IP groups in a simulated composite flight laboratory task. Results of the laboratory task demonstrated superior discrimination performance of the student experimental group over both the student control and experienced pilot groups for the most difficult discrimination. As the discrimination difficulty decreased, the performance of the experimental and experienced pilot groups were equal and both were superior to the student control group. As a measure of the external validity of the laboratory task, both student groups were subjected to four discrete maneuvers in the Williams Air Force Base Human Resources Laboratory, Flying Training Division (AFHRL/FT) Advanced Simulator for Pilot Training (ASPT). Results of the ASPT task support the findings of the laboratory task. The laboratory and simulator results were discussed in the context of directed attention and schema theory. Author (GRA)

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N78-19771* National Aeronautics and Space Administration, Washington, D. C.

NASA DEVELOPS TELEOPERATOR RETRIEVAL SYSTEM

31 Mar. 1978 8 p

(NASA-News-Release-78-49; P78-10047) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 05H

The teleoperator retrieval system vehicle was designed to reboost and/or deorbit the Skylab; however, usefulness in survey, stabilization, retrieval and delivery was examined. Thrusters, designed for cold gas propulsion, were adapted to hydrazine propulsion. Design specifications and cost analysis are given. M.V.

N78-19772*# Life Systems, Inc., Cleveland, Ohio.

TECHNOLOGY ADVANCEMENT OF THE STATIC FEED WATER ELECTROLYSIS PROCESS Final Report

F. H. Schubert and R. A. Wynveen Nov. 1977 89 p refs

(Contract NAS2-8682)

(NASA-CR-152073; LSI-ER-265-7) Avail: NTIS HC A05/MF A01 CSCL 06K

A program to advance the technology of oxygen- and hydrogen-generating subsystems based on water electrolysis was studied. Major emphasis was placed on static feed water electrolysis, a concept characterized by low power consumption and high intrinsic reliability. The static feed based oxygen generation subsystem consists basically of three subassemblies: (1) a combined water electrolysis and product gas dehumidifier module; (2) a product gas pressure controller and; (3) a cyclically filled water feed tank. Development activities were completed at the subsystem as well as at the component level. An extensive test program including single cell, subsystem and integrated system testing was completed with the required test support accessories designed, fabricated, and assembled. Mini-product assurance activities were included throughout all phases of program activities. An extensive number of supporting technology studies were conducted to advance the technology base of the static feed water electrolysis process and to resolve problems. Author

N78-19773*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

END EFFECTOR DEVICE Patent Application

Keith H. Clark, inventors (to NASA) and James D. Johnston Filed 9 Mar. 1978 11 p

(NASA-Case-MFS-23692-1; US-Patent-Appl-SN-885061) Avail: NTIS HC A02/MF A01 CSCL 05H

A lightweight structure adapted for gripping objects of a variety of sizes and shapes with uniform tightness was designed for a mechanical manipulator arm of a space vehicle or other remote manipulator. The end effector device includes a pair of movable jaws in opposed relation for gripping an object. Each jaw has laterally spaced gripping fingers in the form of flat plates. Each finger has a gripping face in which a notch is formed. The gripping fingers of one of the jaws are carried alternately offset with respect to the fingers of the opposed jaw to permit the fingers to intermesh and provide a variably closed channel for gripping objects of various sizes and shapes. The jaws are connected to an adapter mechanism by couplings which include a pair of spaced pivots on which a pair of linkage bars are mounted. Each jaw is connected to its coupling through a flexible cartilage which prevents shearing of connecting rods and pins and provides for more effective gripping action. The adapter mechanism is in turn connected to a mechanical wrist joint of a manipulator arm. NASA

N78-19774# Boeing Aerospace Co., Seattle, Wash.

WINDSHIELD QUALITY AND PILOT PERFORMANCE Technical Report, 1 Jul. 1976 - 1 Jul. 1977

Conrad L. Kraft, Charles D. Anderson, Charles L. Elworth, and Clarence Larry Wright-Patterson AFB, Ohio AMRL Oct. 1977

117 p refs
(Contract F33615-76-C-0516)
(AD-A048457; AMRL-TR-77-39) Avail: NTIS HC A06/MF A01 CSCL 01/3

Two experimental investigations were performed with C-141 pilots making aircraft landings with a 727-200 flight crew training simulator mounted on a three-degree-of-freedom motion base. The terrain image was computer-generated and the 1000 TV line, full color scene was displayed at optical infinity with a resolution of 2.9 arc minutes. All pilots were extensively tested for several skills. Optical distortion panels between the pilot and the visual scene simulated a range of windscreen image qualities from excellent to poor. One study used 8 pilots, 4 windscreen qualities, 2 times-of-day and 2 visibility conditions. A second study used 6 pilots, 3 windscreen qualitites, 2 times-of-day, and 4 replications. In both studies, ten dependent measures were taken of pilot's performance. Decreased windscreen optical quality increased centerline deviations at touchdown point. Windscreen quality and time-of-day significantly interacted. Night approaches with poor windscreens were significantly above glide slope, but on glide slope with better windscreens. Approaches were low for all windscreens in daytime landings. Poor optical quality windscreens caused apparently more cautious night landings: higher faster approaches, more rapid descents and touchdowns that were harder and further down the runway. Recommendations are made for measuring windscreen optical quality effects on flight performance. Author (GRA)

N78-19775# Electro-Voice, Inc., Buchanan, Mich. Military Engineering Dept.
LINEAR NOISE-ATTENUATING EARPHONE Final Report, 28 May 1976 - 21 Aug. 1977
R. Ramsey 4 Nov. 1977 99 p
(Contract DAAB07-76-C-0149)
(AD-A048846; ECOM-76-0149-F) Avail: NTIS HC A05/MF A01 CSCL 09/5

This document covers the technical details of work performed to improve the linearity and attenuation of the earphone and earcup respectively in Flying Type Helmet SPH-4. The results of the effort provide an immersible, salt resistant, rugged and low distortion earphone with a flat frequency response fitting an 8 db response envelope when placed in the newly designed earcup which is lighter in weight but more rugged than the present standard SPH-4. The new ear-cushion utilizes a low permeability foam for improved attenuation in the low and mid-frequency range, which is covered with a urethane film for low temperature flexibility and body oil resistance. Author (GRA)

N78-19776# Aerojet Liquid Rocket Co., Sacramento, Calif.
STORABILITY INVESTIGATIONS OF WATER LONG-TERM STORAGE EVALUATION Annual Report, Nov. 1976 - Oct. 1977
E. M. Vander Wall and G. R. Janser Edwards AFB, Calif. AFRPL Dec. 1977 69 p ref
(Contract F04611-72-C-0062; AF Proj. 3059)
(AD-A049189; AFRPL-TR-77-7423; AR-4) Avail: NTIS HC A04/MF A01 CSCL 13/2

The objective of this program is to gather data that will permit the Air Force to assess the long term storage characteristics of water, particularly with regard to formation of particulate matter, so that the feasibility of long-term storage of water for use as a transpiration coolant can be determined. Five metallic materials of construction are included in the program: 304 stainless steel, A-286 (aged) steel, 17-4 (aged) stainless steel, Inconel 718 (aged), 6Al-4V titanium (STA). Two types of water are used in the program; oxygen-saturated, deionized, filtered, and oxygen-free, deionized, filtered. Five-year storage tests have been initiated in 304 and 17-4 Ph stainless steels, A-286 steel, Inconel 718, and 6Al-4V titanium (STA) containers using the filtered, deionized waters. Evaluation of water and containers stored for forty-two months and forty-eight months has been completed. The data show that both oxygen-saturated and oxygen-free water can be stored in appropriate metal containers for the selected time periods without detrimental particulate matter formation or significant changes in the quality of the water. It is in excellent condition for transportation coolant purposes. Author (GRA)

N78-19777# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
IDENTIFICATION OF ALPHABETIC SYMBOLS AS A FUNCTION OF THEIR LOCATION IN THE VISUAL PERIPHERY
Shelton MacLeod Oct. 1977 24 p refs
(AD-A049345; AMRL-TR-77-37) Avail: NTIS HC A02/MF A01 CSCL 06/16

A preliminary study in a proposed program of research to develop improved design criteria for peripheral vision displays was performed. Binocular peripheral identification of alphabetic symbols was measured for four subjects at four angular distances from a fixation point (3, 6, 12, and 24 degrees) and along eight equally spaced meridia in the visual field. Response measures were choice reaction time and accuracy scores. Results show: (1) a relatively constant and high level of peripheral identification along all meridia out to a 12-degree, angular distance from central fixation; (2) extension of this high identification performance out to 24 degrees along both right and left horizontal meridia; (3) significant differences in peripheral identifiability of the four alphabetic symbols used; (4) no significant bilateral performance differences related to dual cerebral control. An important display implication of the data concerns the potential advantage of placing letters to be identified in the periphery along the horizontal visual axis. Author (GRA)

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N78-19778*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FUTURE COMPUTER REQUIREMENTS FOR COMPUTATIONAL AERODYNAMICS
Feb. 1978 515 p refs Proceedings held at Moffett Field, Calif., 4-6 Oct. 1977
(NASA-CP-2032; A-7291) Avail: NTIS HC A22/MF A01 CSCL 09B

Recent advances in computational aerodynamics are discussed as well as motivations for and potential benefits of a National Aerodynamic Simulation Facility having the capability to solve fluid dynamic equations at speeds two to three orders of magnitude faster than presently possible with general computers. Two contracted efforts to define processor architectures for such a facility are summarized. For individual titles, see N78-19779 through N78-19819.

N78-19779*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTATIONAL AERODYNAMICS AND THE NUMERICAL AERODYNAMIC SIMULATION FACILITY c02
Victor L. Peterson *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 5-30 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

Technical and economic reasons for accelerating the maturation of the discipline of computational aerodynamics include the cost of conducting the experiments required to provide the empirical data base for new aeronautical vehicles and the limitations in test facilities (Reynolds number, wall and support interferences, aeroelastic distortions, real-gas effects, etc.) for simulating the full-scale vehicle environment. General purpose

computers do not have the necessary capability for the next stage of development. Solution of the three dimensional Reynolds averaged Naiver-Stokes equations in a short time to be practical for design purposes will require 40 times the power of current supercomputers. However, it is feasible to construct a special purpose processor that will meet these requirements to enhance the nation's aerodynamic design capability in the 1980's. Author

N78-19780*# California Univ., Berkeley.
COMPUTING TECHNOLOGY IN THE 1980'S c60
Harold S. Stone *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 31-32 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

Advances in computing technology have been led by consistently improving semiconductor technology. The semiconductor industry has turned out ever faster, smaller, and less expensive devices since transistorized computers were first introduced 20 years ago. For the next decade, there appear to be new advances possible, with the rate of introduction of improved devices at least equal to the historic trends. The implication of these projections is that computers will enter new markets and will truly be pervasive in business, home, and factory as their cost diminishes and their computational power expands to new levels. The computer industry as we know it today will be greatly altered in the next decade, primarily because the raw computer system will give way to computer-based turn-key information and control systems. Author

N78-19781*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THREE-DIMENSIONAL COMPUTATIONAL AERODYNAMICS IN THE 1980'S c61
Harvard Lomax *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 33-38 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

The future requirements for constructing codes that can be used to compute three-dimensional flows about aerodynamic shapes should be assessed in light of the constraints imposed by future computer architectures and the reality of usable algorithms that can provide practical three-dimensional simulations. On the hardware side, vector processing is inevitable in order to meet the CPU speeds required. To cope with three-dimensional geometries, massive data bases with fetch/store conflicts and transposition problems are inevitable. On the software side, codes must be prepared that: (1) can be adapted to complex geometries, (2) can (at the very least) predict the location of laminar and turbulent boundary layer separation, and (3) will converge rapidly to sufficiently accurate solutions. Author

N78-19782*# Burroughs Corp., Paoli, Pa.
NUMERICAL AERODYNAMICS SIMULATION FACILITY PRELIMINARY STUDY, EXECUTIVE SUMMARY Final Report c61
In NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 41-62 (For availability see N78-19778 10-59)
(Contract NAS2-9456)
Avail: NTIS HC A22/MF A01 CSCL 09B

The Burroughs Corporation solution to the problem of numeric aerodynamic simulation consists of a computing system designed to meet an effective throughput of one billion floating point operations per second for three-dimensional Navier-Stokes codes. In order to fully appreciate the design, its features, and subtleties, the methodology of the study which evolved this solution and the impact on the processor architecture evolution are described as well as details of the baseline design. Author

N78-19783*# Control Data Corp., Minneapolis, Minn.
PRELIMINARY STUDY FOR A NUMERICAL AERODYNAMIC SIMULATION FACILITY Summary Report c61
N. R. Lincoln *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 63-79 (For availability see N78-19778 10-59)
(Contract NAS2-9457)
Avail: NTIS HC A22/MF A01 CSCL 09B

The state of the art of relevant technologies, of systems and processor architectures, and the measurable computational requirements of the two existing Navier-Stokes solution programs were assessed by Control Data Corporation to determine the best approach for designing a system for aerodynamic simulation. Standard parts and components were used to identify the support processing system, which is composed of commercially available equipment and software. Technological achievements in large scale integration technology and system organization of subcomponents borrowed from the STAR-100C project were used in the design of the Navier-Stokes solver. A.R.H.

N78-19784*# Boeing Co., Seattle, Wash.
COMPUTATIONAL AERODYNAMICS REQUIREMENTS: THE FUTURE ROLE OF THE COMPUTER AND THE NEEDS OF THE AEROSPACE INDUSTRY c60
Paul E. Rubbert *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 81-90 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

The commercial airplane builder's viewpoint on the important issues involved in the development of improved computational aerodynamics tools such as powerful computers optimized for fluid flow problems is presented. The primary user of computational aerodynamics in a commercial aircraft company is the design engineer who is concerned with solving practical engineering problems. From his viewpoint, the development of program interfaces and pre-and post-processing capability for new computational methods is just as important as the algorithms and machine architecture. As more and more details of the entire flow field are computed, the visibility of the output data becomes a major problem which is then doubled when a design capability is added. The user must be able to see, understand, and interpret the results calculated. Enormous costs are expanded because of the need to work with programs having only primitive user interfaces. Author

N78-19785*# General Dynamics/Fort Worth, Tex.
REMARKS ON FUTURE COMPUTATIONAL AERODYNAMICS REQUIREMENTS c61
R. G. Bradley and I. C. Bhateley *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 91-101 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

The development of upgraded and expanded computational aerodynamics methods for the design and analysis of aircraft configurations should be performed by both government and industry to ensure that the objectives for aircraft design are satisfied from both the industrial competitive design standpoint and from the government standpoint. Any programs developed must be heavily user-oriented and provide maximum visibility and creditability to management. Early consideration should be given to the adequate management of such a facility when it becomes available. Author

N78-19786*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FUTURE REQUIREMENTS AND ROLES OF COMPUTERS IN AERODYNAMICS c60
Thomas J. Gregory *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 102-107 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

While faster computers will be needed to make solution of the Navier-Stokes equations practical and useful, most all of the other aerodynamic solution techniques can benefit from faster computers. There is a wide variety of computational and measurement techniques, the prospect of more powerful computers permits extension and an enhancement across all aerodynamic methods, including wind-tunnel measurement. It is expected that, as in the past, a blend of methods will be used to predict aircraft aerodynamics in the future. These will include methods based on solution of the Navier-Stokes equations and the potential flow equations as well as those based on empirical and measured results. The primary flows of interest in aircraft aerodynamics are identified, the predictive methods currently in use and/or under development are reviewed and two of these methods are analyzed in terms of the computational resources needed to improve their usefulness and practicality. Author

N78-19787*# Lockheed-Georgia Co., Marietta.
PROJECTED ROLE OF ADVANCED COMPUTATIONAL AERODYNAMIC METHODS AT THE LOCKHEED-GEORGIA COMPANY **c61**
Manuel E. Lores *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 108-120 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

Experience with advanced computational methods being used at the Lockheed-Georgia Company to aid in the evaluation and design of new and modified aircraft indicates that large and specialized computers will be needed to make advanced three-dimensional viscous aerodynamic computations practical. The Numerical Aerodynamic Simulation Facility should be used to provide a tool for designing better aerospace vehicles while at the same time reducing development costs by performing computations using Navier-Stokes equations solution algorithms and permitting less sophisticated but nevertheless complex calculations to be made efficiently. Configuration definition procedures and data output formats can probably best be defined in cooperation with industry, therefore, the computer should handle many remote terminals efficiently. The capability of transferring data to and from other computers needs to be provided. Because of the significant amount of input and output associated with 3-D viscous flow calculations and because of the exceedingly fast computation speed envisioned for the computer, special attention should be paid to providing rapid, diversified, and efficient input and output. Author

N78-19788*# ARO, Inc., Arnold Air Force Station, Tenn.
COMPUTATIONAL AERODYNAMICS REQUIREMENTS IN CONJUNCTION WITH EXPERIMENTAL FACILITIES **c61**
J. Leith Potter and John C. Adams *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 121-131 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

The importance computational aerodynamics in improving quality and efficiency in production of information at a wind tunnel test center is discussed. Some principal applications of the calculations are to extend or clarify the understanding of experimental data, particularly when wind tunnel or scaling limitations prevent attainment of all conditions of interest, and to furnish on-line or near-on-line math-model results or other comparative data needed for test direction. Author

N78-19789*# Boeing Co., Seattle, Wash.
COMPUTATIONAL FLUID DYNAMICS (CFD): FUTURE ROLE AND REQUIREMENTS AS VIEWED BY AN APPLIED AERODYNAMICIST **c34**
H. Yoshihara *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 132-142 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

The problem of designing the wing-fuselage configuration of an advanced transonic commercial airliner and the optimization of a supercruiser fighter are sketched, pointing out the essential fluid mechanical phenomena that play an important role. Such problems suggest that for a numerical method to be useful, it must be able to treat highly three dimensional turbulent separations, flows with jet engine exhausts, and complex vehicle configurations. Weaknesses of the two principal tools of the aerodynamicist, the wind tunnel and the computer, suggest a complementing combined use of these tools, which is illustrated by the case of the transonic wing-fuselage design. The anticipated difficulties in developing an adequate turbulent transport model suggest that such an approach may have to suffice for an extended period. On a longer term, experimentation of turbulent transport in meaningful cases must be intensified to provide a data base for both modeling and theory validation purposes. Author

N78-19790*# Sandia Labs., Albuquerque, N. Mex.
COMPUTATIONAL REQUIREMENTS FOR THREE-DIMENSIONAL FLOWS **c34**
F. G. Blottner *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 145-153 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

The computational requirements needed for predicting steady viscous flow over complex configurations are considered. The desired predictions must be made at reasonable expense, require a reasonable amount of storage space, and result in solutions that are sufficiently accurate. The data needed to estimate the cost of Navier-Stokes solutions is not available; therefore, experience with the solution of the three-dimensional boundary layers equations are used to illustrate the needed information and what can be expected for the Navier-Stokes solutions. Author

N78-19791*# McDonnell-Douglas Research Labs., St. Louis, Mo.
VISCOUS FLOW SIMULATIONS IN VTOL AERODYNAMICS **c02**
W. W. Bower *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 154-167 refs (For availability see N78-19778 10-59)
(Contract N00014-76-C-0494)
Avail: NTIS HC A22/MF A01 CSCL 01A

The critical issues in viscous flow simulations, such as boundary-layer separation, entrainment, turbulence modeling, and compressibility, are discussed with regard to the ground effects problem for vertical-takeoff-and-landing (VTOL) aircraft. A simulation of the two-dimensional incompressible lift jet in ground proximity is based on solution of the Reynolds-averaged Navier-Stokes equations and a turbulence-model equation which are written in stream function-vorticity form and are solved using Hoffman's augmented-central-difference algorithm. The resulting equations and their shortcomings are discussed when the technique is extended to two-dimensional compressible and three-dimensional incompressible flows. Author

N78-19792*# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
CRITICAL ISSUES IN VISCOUS FLOW COMPUTATIONS **c34**
W. L. Hankey *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 168-175 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

In developing computer programs to numerically solve the Navier-Stokes equations, the purpose of the computation must be clearly kept in mind. In the Air Force, the purpose is to provide design information on non-linear aerodynamic phenomenon for aircraft that perform throughout the flight corridor. This translates into the requirement for a computer program which can solve the time averaged compressible Navier-Stokes equations (with a turbulence model) in three dimensions for generalized geometries. The intended application of the results then controls the priorities in addressing critical issues. Recurrent problem areas encountered in the study of viscous flow include: (1) grid generation for arbitrary geometry; (2) numerical difficulties; (3) turbulence models; (4) accuracy and efficiency; and (5) smearing of discontinuities. Author

N78-19793*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VISCOUS FLOW SIMULATION REQUIREMENTS **c34**
Julius E. Harris *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 176-208 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 20D

Although significant advances have been made in the simulation of two-dimensional compressible laminar viscous flows by numerically solving the compressible Navier-Stokes (N.S.) equations, problem areas still remain to be solved before viscous flows requiring solution of the compressible N.S. equations can be efficiently and accurately simulated for flows of aerodynamic interest. These problem areas include turbulence (three-dimensional character), complex geometry, flow unsteadiness, placement of artificial boundaries relative to solid boundaries, specification of boundary conditions, and large flow gradients near surfaces and in the vicinity of shock waves for supersonic flows. Author

N78-19794*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPUTING VISCOUS FLOWS c34

J. D. Murphy *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 209-220 refs (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 20D

Although the goals and techniques of computational aerodynamics and computational fluid dynamics differ, advancement in the physical and mathematical aspects of the latter are required for progress in aerodynamic computation. The most attractive approach is the use of hybrid methods where both the equations treated and the solution algorithms reflect the local character of the flow. A working general turbulence model that is only peripherally related to the availability of large fast computers would provide a significant breakthrough in computational aerodynamics. There is no unanimity of opinion as to what may be the optimum algorithm or family of algorithms in the next decade. While it is premature to develop an optimum processor, such a machine dedicated to study the structure of solutions to the three-dimensional time-dependent Navier-Stokes equations and to the computability of turbulence would be very valuable.

A.R.H.

N78-19795*# Georgia Inst. of Tech., Atlanta.

PROSPECTS FOR COMPUTATIONAL AERODYNAMICS c02

J. C. Wu *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 221-227 refs (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 01A

The integral representations approach, for the solution of the Navier-Stokes equations is discussed as well as experience in its development and in applying available finite-difference and finite-element techniques to the treatment of three-dimensional problems, and the computation of turbulent flow. The magnitude of efforts required to develop turbulence models and three-dimensional algorithms indicates that the computational fluid dynamics research must have a broad base. Broader access to modern computing facilities that are in existence within NASA should be promoted for active researchers not directly affiliated with that agency.

Author

N78-19796*# Stanford Univ., Calif. Dept. of Mechanical Engineering.

LEVELS OF TURBULENCE PREDICTION c61

Joel H. Ferziger and Stephen J. Kline *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 229-238 refs (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

A classification according to the level of detail of description the computational method provides is probably most useful. Flow calculations can be classified into five categories: (1) correlations; (2) zonal method; (3) time-averaged equations; (4) large-eddy simulation; and (5) Navier-Stokes solution. There are methods that fall into more than one category, and there are sub-divisions of each category. A discussion of the advantages and disadvantages of each of these five categories is given.

Author

N78-19797*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MODELING OF THE REYNOLDS STRESSES c02

Morris W. Rubesin *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 239-247 (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 01A

In their most general form, the Reynolds averaged conservation equations result from ensemble or time averages of the instantaneous Navier-Stokes equations or their compressible counterparts. For these averaging processes to be consistent, the averaging time period must exceed the periods identified with the largest time scales of the turbulence, and yet be shorter than the characteristic times of the flow field. With these equations long period variations in the flow fields are deterministic, provided initial conditions are known. The average dependent variables are sufficiently smooth to be resolvable by finite difference techniques consistent with the size and speed of modern computers.

Author

N78-19798*# Boeing Military Airplane Development Seattle, Wash.

TURBULENCE MODELS FROM THE POINT OF VIEW OF AN INDUSTRIAL USER c61

S. F. Birch *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 248-259 refs (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

Since there appears to be little prospect of the development of methods for the solution of the full, time dependent Navier-Stokes equations in the near future, the need continues for turbulence models to approximate the Reynolds stress terms that appear in the time averaged Navier-Stokes equations. Even if methods were available for solving the full equations, this would not necessarily be the optimum choice in all cases. As the cost of numerical computations decreases, the trend toward the use of more complex methods is likely to continue, but there will always be a need for a range of methods, depending on the accuracy and detail required from the calculation.

Author

N78-19799*# Texas Univ., Arlington.

A DUAL ASSAULT UPON TURBULENCE c34

F. R. Payne *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 260-266 refs (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 20D

All known calculation methods incorporate some sort of turbulence model to reduce the infinite hierarchy of equations, under Reynolds' averaging, to a finite set. All such models suffer from a certain ad hoc nature. A dual structure model was developed wherein the turbulence field is, somewhat arbitrarily, decomposed into large eddies which presumably are dominant contributors to the Reynolds' stress and small eddies which feed on the large eddies as these, in turn feed upon the average flow to gain their energy. These concepts have been developed into a dual approach, one extractive and the other predictive as outlined below.

Author

N78-19800*# Mississippi State Univ., Mississippi State. Dept. of Aerophysics and Aerospace Engineering.

REMARKS ON BOUNDARY-FITTED COORDINATE SYSTEM GENERATION c61

Joe F. Thompson *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 267-277 refs (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

The essential part of numerical solutions of partial differential equations is the representation of gradients and integrals by, respectively, differences between points and summations over points. In order for such numerical representations to be accurate, it is necessary that these points be more closely spaced in regions of large gradients. The need for accurate representation is particularly acute near body surfaces, since the boundary conditions are generally the most influential part of a partial differential equation solution. This is especially true of viscous solutions at high Reynolds number, where very large gradients occur in the boundary layer.

Author

N78-19801*# Tennessee Univ., Knoxville.

FINITE ELEMENT CONCEPTS IN COMPUTATIONAL AERODYNAMICS c61

A. J. Baker *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 278-289 refs (For availability see N78-19778 10-59)

(Contract NAS1-14307; Grants NsG-1261; NsG-1391)

Avail: NTIS HC A22/MF A01 CSCL 09B

Finite element theory was employed to establish an implicit numerical solution algorithm for the time averaged unsteady Navier-Stokes equations. Both the multidimensional and a time-split form of the algorithm were considered, the latter of particular interest for problem specification on a regular mesh. A Newton matrix iteration procedure is outlined for solving the resultant nonlinear algebraic equation systems. Multidimensional discretization procedures are discussed with emphasis on automated generation of specific nonuniform solution grids and accounting of curved surfaces. The time-split algorithm was evaluated with regards to accuracy and convergence properties for hyperbolic equations on rectangular coordinates. An overall

assessment of the viability of the finite element concept for computational aerodynamics is made. Author

N78-19802*# Boeing Aerospace Co., Seattle, Wash.
SOME MESH GENERATION REQUIREMENTS AND METHODS **c61**
Lawrence J. Dickson *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 290-294 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

Discretized solution algorithms, which find solutions of field equations in a two or three dimensional field, generally use meshes which are fitted to the field boundary to allow convenient formulation of boundary conditions there. A mesh is defined to be the image of a rectangular grid in computational space under a mesh mapping which maps computational space into physical space. It is not necessary that all of computational space be mapped onto the region of interest in physical space. Parts of it can be excised to give a better fit to the boundary. Many different excisions can be made to fit a single boundary; the choice depends on the mesh arrangement desired in the field. Author

N78-19803*# Michigan Univ., Ann Arbor. Systems Engineering Lab.
A STUDY OF A MULTIPLE CRAY-1 FOR FLUID MECHANICS SIMULATION **c60**
D. A. Calahan, P. G. Buning, D. A. Orbits, and W. G. Ames *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 296-326 refs (For availability see N78-19778 10-59)
(Grant AF-AFOSR-2812-75)
(SEL-113) Avail: NTIS HC A22/MF A01 CSCL 09B

A study of the performance of the CRAY-1 and its architectural extensions was performed on 2-D and 3-D codes for the solution of the Navier-Stokes equations describing aerodynamic fluid flow. A standard 2-D code was benchmarked on the CRAY-1 and a preliminary version of a simulator of the CRAY-1 was programmed. Author

N78-19804*# Colorado State Univ., Fort Collins. Computer Science Dept.
REVIEW OF THE AIR FORCE SUMMER STUDY PROGRAM ON THE INTEGRATION OF WIND TUNNELS AND COMPUTERS **c62**
Bernard W. Marschner *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 326-334 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

The present state of computational fluid dynamics and its impact on the design cycle and computer requirements for future developments in this field were explored. The increase in productivity and efficiency which experimental facilities can achieve by a close integration with computers was investigated together with possible improvements in simulation quality of wind tunnels in conjunction with computer control. Research experiments are outlined to provide a better understanding of the physics of fluid flow and to assist in the modeling of these phenomena for computational methods, with primary emphasis on turbulent flows. Author

N78-19805*# IBM Research Lab., San Jose, Calif.
MULTIPROCESSING TRADEOFFS AND THE WIND-TUNNEL SIMULATION PROBLEM **c60**
Tien Chi Chen *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 335-342 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

The architecture tradeoff issue is discussed, concentrating on an oversimplified version of the multiprocessing aspect. A degree of symmetric multiprocessing is unavoidable; the choice is either complete symmetric multiprocessing or a number of identical pipelines. The processing elements can be geared to do either plane-multiprocessing, or line-multiprocessing. Other important design choices are the number notation, word length, main memory size, cache memory size, and different means to implement data transport. Author

N78-19806*# Texas Instruments, Inc., Dallas.
TECHNOLOGY ADVANCES AND MARKET FORCES: THEIR IMPACT ON HIGH PERFORMANCE ARCHITECTURES **c60**
Dennis R. Best *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 343-353 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

Reasonable projections into future supercomputer architectures and technology require an analysis of the computer industry market environment, the current capabilities and trends within the component industry, and the research activities on computer architecture in the industrial and academic communities. Management, programmer, architect, and user must cooperate to increase the efficiency of supercomputer development efforts. Care must be taken to match the funding, compiler, architecture and application with greater attention to testability, maintainability, reliability, and usability than supercomputer development programs of the past. Author

N78-19807*# Institute for Advanced Computation, Sunnyvale, Calif.
GIGAFLOP ARCHITECTURE, A HARDWARE PERSPECTIVE **c60**
Gary F. Feierbach *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 354-362 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

Any super computer built in the early 1980s will use components that are available by fall 1978. The architecture of such a system cannot depart radically from current super computers if the software experience painfully acquired from these computers in the 70's is to apply. Given the above constraints, 10 billion floating point operations per second (BFLOPS) are attainable and a problem memory of 512 million (64 bit) words could be supported by the technology of the time. In contrast to this, industry is likely to respond with commercially available machines with a performance of less than 150 MFLOPS. This is due to self-imposed constraints on the manufacturers to provide upward compatible architectures (same instruction set) and systems which can be sold in significant volumes. Since this computing speed is inadequate to meet the demands of computational fluid dynamics, a special processor is required. Issues which are felt to be significant in the pursuit of maximum compute capability in this special processor are discussed. Author

N78-19808*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SINGLE USER EFFICIENCY MEASURE FOR EVALUATION OF PARALLEL OR PIPELINE COMPUTER ARCHITECTURES **c60**
W. P. Jones *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 363-371 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

A precise statement of the relationship between sequential computation at one rate, parallel or pipeline computation at a much higher rate, the data movement rate between levels of memory, the fraction of inherently sequential operations or data that must be processed sequentially, the fraction of data to be moved that cannot be overlapped with computation, and the relative computational complexity of the algorithms for the two processes, scalar and vector, was developed. The relationship should be applied to the multirate processes that obtain in the employment of various new or proposed computer architectures for computational aerodynamics. The relationship, an efficiency measure that the single user of the computer system perceives, argues strongly in favor of separating scalar and vector processes, sometimes referred to as loosely coupled processes, to achieve optimum use of hardware. Author

N78-19809*# SRI International Corp., Menlo Park, Calif.
THE INDIRECT BINARY N-CUBE ARRAY **c60**
Marshall Pease *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1977 p 372-380 refs (For availability see N78-19778 10-59)
(Grant NSF GJ-42696)

Avail: NTIS HC A22/MF A01 CSCL 09B

The array is built from a large number (hundreds or thousands) of microprocessors or microcomputers linked through a switching network into an indirect binary n-cube array. Control is two level, the array operating synchronously, or in lock step, at the higher level, and with the broadcast commands being locally interpreted into rewritable microinstruction streams in the microprocessors and in the switch control units. The key to the design is the switching array. By properly programming it, the array can be made into a wide variety of virtual arrays which are well adapted to a wide range of applications. It is believed that the flexibility of the switching array can be used to obtain fault avoidance, which appears necessary in any highly parallel design. Author

N78-19810*# California Univ., Los Angeles. Center for Plasma Physics and Fusion Engineering.

METHODOLOGY OF MODELING AND MEASURING COMPUTER ARCHITECTURES FOR PLASMA SIMULATIONS **c60**

Li-ping Thomas Wang *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1977 p 381-393 refs (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 05B

A brief introduction to plasma simulation using computers and the difficulties on currently available computers is given. Through the use of an analyzing and measuring methodology - SARA, the control flow and data flow of a particle simulation model REM2-1/2D are exemplified. After recursive refinements the total execution time may be greatly shortened and a fully parallel data flow can be obtained. From this data flow, a matched computer architecture or organization could be configured to achieve the computation bound of an application problem. A sequential type simulation model, an array/pipeline type simulation model, and a fully parallel simulation model of a code REM2-1/2D are proposed and analyzed. This methodology can be applied to other application problems which have implicitly parallel nature. Author

N78-19811*# R and D Associates, Marina Del Rey, Calif.

TOTAL SYSTEM ISSUES **c62**

John M. Levesque *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 395-403 (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

A raw computer resource capable of one billion floating point operations per second will have multiple parallel and/or segmented functional units to obtain such a speed. The system programmers, software writers and users are faced with the task of writing operating systems, compilers and application programs to utilize such a capability efficiently. The software problem of giving the user access to the available power of the machine is discussed. Author

N78-19812*# Institute for Advanced Computation, Sunnyvale, Calif.

A HIGH LEVEL LANGUAGE FOR A HIGH PERFORMANCE COMPUTER **c60**

R. H. Perrott *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 409-417 refs (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

The proposed computational aerodynamic facility will join the ranks of the supercomputers due to its architecture and increased execution speed. At present, the languages used to program these supercomputers have been modifications of programming languages which were designed many years ago for sequential machines. A new programming language should be developed based on the techniques which have proved valuable for sequential programming languages and incorporating the algorithmic techniques required for these supercomputers. The design objectives for such a language are outlined. Author

N78-19813*# Boeing Computer Services, Inc., Seattle, Wash.

USER INTERFACE CONCERNS **c62**

David D. Redhed *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 418-422 (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

Three possible goals for the Numerical Aerodynamic Simulation Facility (NASF) are: (1) a computational fluid dynamics (as opposed to aerodynamics) algorithm development tool; (2) a specialized research laboratory facility for nearly intractable aerodynamics problems that industry encounters; and (3) a facility for industry to use in its normal aerodynamics design work that requires high computing rates. The central system issue for industry use of such a computer is the quality of the user interface as implemented in some kind of a front end to the vector processor. Author

N78-19814*# Institute for Advanced Computation, Sunnyvale, Calif.

SPECIALIZED COMPUTER ARCHITECTURES FOR COMPUTATIONAL AERODYNAMICS **c60**

David K. Stevenson *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 423-428 (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

In recent years, computational fluid dynamics has made significant progress in modelling aerodynamic phenomena. Currently, one of the major barriers to future development lies in the compute-intensive nature of the numerical formulations and the relative high cost of performing these computations on commercially available general purpose computers, a cost high with respect to dollar expenditure and/or elapsed time. Today's computing technology will support a program designed to create specialized computing facilities to be dedicated to the important problems of computational aerodynamics. One of the still unresolved questions is the organization of the computing components in such a facility. The characteristics of fluid dynamic problems which will have significant impact on the choice of computer architecture for a specialized facility are reviewed. Author

N78-19815*# California Inst. of Tech., Pasadena.

SUGGESTED ARCHITECTURE FOR A SPECIALIZED FLUID DYNAMICS COMPUTER **c60**

Bengt Fornberg *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 429-434 (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

Future flow simulations in 3-D will require computers with extremely large main memories and an advantageous ratio between computer cost and arithmetic speed. Since random access memories are very expensive, a pipeline design is proposed which allows the use of much cheaper sequential devices without any sacrifice in speed for vector references (even with arbitrary spacing between successive elements). Also scalar arithmetic can be performed efficiently. The comparatively low speed of the proposed machine (about 10 to the 7th power operations per second) would be offset by a very low price per unit, making mass production possible. Author

N78-19816*# SRI International Corp., Menlo Park, Calif.

MICROPROCESSOR ARRAYS FOR LARGE SCALE COMPUTATION **c60**

William H. Kautz *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 435-445 (For availability see N78-19778 10-59)

Avail: NTIS HC A22/MF A01 CSCL 09B

An important new direction in computer architecture centers around the achievement of very high computational power (capacity, speed and reliability) through the use of tens of thousands of microprocessors, micromemories, and switch modules, all interconnected into a large homogeneous network using one of certain advanced connection schemes. When surrounded and supported by conventional computers and memories, such a machine holds potential for out-performing both conventional and array-based computers of the mid-1980's by one to two orders of magnitude, at least for particular classes of applications amenable to high parallelism, such as aerodynamic simulation. The homogeneous feature of this machine concept also implies size extendability, fault tolerance, and improved flexibility to handle a variety of algorithms of interest. Current work is addressing the design of technologically efficient interconnection configurations and the development of new

computation algorithms that are especially efficient for highly parallel computation. Author

N78-19817*# RAND Corp., Santa Monica, Calif.
FEASIBILITY OF A SPECIAL-PURPOSE COMPUTER TO SOLVE THE NAVIER-STOKES EQUATIONS c60
E. C. Gritton, W. S. King, I. Sutherland, R. S. Gaines, C. Gazley, Jr., C. Grosch, M. Juncosa, and H. Petersen *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 446-456 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

Orders-of-magnitude improvements in computer performance can be realized with a parallel array of thousands of fast microprocessors. In this architecture, wiring congestion is minimized by limiting processor communication to nearest neighbors. When certain standard algorithms are applied to a viscous flow problem and existing LSI technology is used, performance estimates of this conceptual design show a dramatic decrease in computational time when compared to the CDC 7600. Author

N78-19818*# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
A MODULAR MINICOMPUTER BASED NAVIER-STOKES SOLVER c60
John Steinhoff *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 457-470 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

The basic module consists of a minicomputer, low cost peripheral storage device (disk) and a modest number (8-12) of microcomputer modules. A simple arrangement, where the microcomputers are connected to a single time multiplexed bus, only communicating to the host minicomputer, will be efficient. By running the machine in a dedicated mode for long periods of time, it will be possible to obtain a large number of solutions. As such, the device should be useful as a research tool. A scheme is outlined to assemble a number of these computing modules in parallel to decrease computing time. The advantages and disadvantages are discussed of using a number of these systems assembled in a loosely coupled configuration, each independently computing a separate flow, to give a very high throughput. Author

N78-19819*# Aerospace Corp., Los Angeles, Calif.
COMPUTATIONAL ADVANCES IN FLUID DYNAMICS c60
T. D. Taylor *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 471-483 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

An office size digital computer with capabilities exceeding a CDC 7600 can be constructed for less than 300 K and spectral methods offer a factor ten improvement over finite difference methods. Integration of these facts can produce two orders of magnitude reduction in cost of fluid dynamic computations and permit solution of 3-D problems which were not previously feasible. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering.*

N78-19820 Ohio State Univ., Columbus.
DESIGN OF EVENT-DRIVEN PROTECTION MECHANISMS Ph.D. Thesis
David Cohen 1977 312 p
Avail: Univ. Microfilms Order No. 77-31846

An attempt was made to include protection mechanisms in which access decisions depend upon additional factors such as user's access history and system's data. The protection mechanism includes three major processes, the authorization process, the monitoring process, and the enforcement process. A detailed analysis of the system was provided, including major design tradeoffs with respect to storage and processing requirements. The protection mechanism can adjust the level of data sharing supported according to the operating system resources available. The effect of multiprocessing, reliability and distribution of the data base system on query processing was examined.
Dissert. Abstr.

N78-19821 Ohio State Univ., Columbus.
DECISION MAKING WITH FINITE MEMORY DEVICES Ph.D. Thesis
K. B. Lakshmanan 1977 175 p
Avail: Univ. Microfilms Order No. 77-31910

The effects of finite memory constraints on decision theoretical problems was studied. The decisions were based on a finite valued statistic, which can be stored in a finite number of bits of computer memory. The results presented may be viewed as specifying the capabilities of finite memory devices in statistical decision making similar to the results on the recognition capabilities of finite state automata or as specifying the memory complexity of statistical decision theory algorithms. The particular problems studied were: multiple simple hypothesis testing, compound hypothesis testing, and the two armed bandit problem. In all these cases, the aim was to derive nontrivial lower bounds on error probabilities achievable by automata of specified memory capacity, and to design automata whose performances match or are close to the bounds. Dissert. Abstr.

N78-19822 Missouri Univ., Columbia.
OPERATING SYSTEM FOR A LARGE SCALE HYBRID COMPUTER INCLUDING SELF TESTING Ph.D. Thesis
Howard Kee-How Lee 1977 323 p
Avail: Univ. Microfilms Order No. 77-31737

The complete requirements for a high performance, foreground/background operating system, and the detailed design of such a system including its application for hybrid computer self testing was presented. Maximum run time efficiency, high speed real time data transfer control and data logging, system reliability analysis, and powerful interaction between digital subsystem and analog subsystem were emphasized.
Dissert. Abstr.

N78-19823 Texas A&M Univ., College Station.
DESIGN OF AN INTELLIGENT DATA COMMUNICATION MULTIPLEXER Ph.D. Thesis
Charles Wallis McMath, Jr. 1977 119 p
Avail: Univ. Microfilms Order No. 77-32179

A set of functional characteristics was developed for the multiplexer. The multiplexer supports up to four terminals. Data is transmitted in blocks for each port and includes an error detection and retransmission capability. Each block of data is fully buffered to allow the baud rates of the communication line between two multiplexers to be less than between each multiplexer and its local ports. Data is compressed before transmission if possible. The development of the hardware components was presented which includes all major steps from the initial design through final testing. The operating characteristics of the multiplexer were specified in the firmware that drives the microprocessor. Dissert. Abstr.

N78-19824 Texas A&M Univ., College Station.
DESIGN AND VERIFICATION OF COMPUTER PERFORMANCE MEASURE EVALUATION ANALYSIS TECHNIQUES Ph.D. Thesis
Pedro Sanabria 1977 110 p
Avail: Univ. Microfilms Order No. 77-32199

A technique is presented to collect information about the behavior of the system while performing a data processing task. The technique included the identification of system states, the selection of events relating the performance of a given component and the selection of an adequate data collection tool with corresponding elements such as probes, recording devices and measurement interfaces. The performance of a system was thought to be a complex function of the performance of its components. A method to define and measure performance variables is described. The terminology and concepts apply to any level of performance. The performance measures represented the

performance of individual resources and the performance of the resources operating concurrently. Dissert. Abstr.

N78-19825# Federal COBOL Compiler Testing Service, Washington, D. C.
COBOL COMPILER VALIDATION SUMMARY REPORT
6 Jan. 1978 70 p
(AD-A048318; CCVS74-VSR270) Avail: NTIS HC A04/MF A01 CSCL 09/2
For abstract, see N78-18779.

N78-19826# Stanford Univ., Calif. Electronics Labs.
INTERPRETIVE MACHINE
John K. Iliffe Jun. 1977 51 p
(Contract N00014-75-C-0601)
(AD-A048638; SU-SEL-77-030; SU-DSL-149) Avail: NTIS HC A04/MF A01 CSCL 09/2

The lecture survey attempts to apply computers directly to high level languages using microprogrammed interpreters. The motivation for such work is to achieve language implementations that are more effective in some measure of translation, execution, or response to the user than would otherwise be obtained. The implied comparison is with the established technique of compiling into a fixed general-purpose machine code prior to execution. It is argued that while substantial benefits can be expected from microprogramming it does not represent the best approach to design when the contributing factors are analyzed in a general system context, that is to say when wide performance range, multiple source language, and stringent security requirements have to be satisfied. An alternative is suggested, using a combination of interpretive and a primitive instruction set and providing security at the microprogram level. Author (GRA)

N78-19827# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
RECOMMENDATION FOR ACCAT/FNWC INTERFACE
R. Thomas Jun. 1977 25 p
(Contract N00039-77-C-0239; ARPA Order 3175)
(AD-A048440; BBN-3727) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report recommends an approach for interfacing the Fleet Numerical Weather Center (FNWC) to the Advanced Command Control Architectural Testbed (ACCAT). In addition, it details the hardware and software required to accomplish the interface and estimates the cost to procure, install, and maintain the required hardware. Author (GRA)

N78-19828# Federal COBOL Compiler Testing Service, Washington, D. C.
COBOL COMPILER VALIDATION SUMMARY REPORT
29 Dec. 1977 70 p
(AD-A048443; CCVS74-VSR230) Avail: NTIS HC A04/MF A01 CSCL 09/2

This Validation Summary Report (VSR) for the UNIVAC 1100 Series ASCII/ANSI COBOL Compiler Version Level 4R1 (EXEC-8 Version 33R2) provides a consolidated summary of the results obtained from the validation of the subject compiler against the 1974 COBOL Standard (X3.23-1974/FIPS PUB 21-1). The compiler was validated at the High level of FIPS PUB 21-1. The VSR is made up of several sections showing the discrepancies found. These include an overview of the validation which lists all categories of discrepancies by level/module within X3.23-19, a section relating the categories of discrepancies to each of the Federal levels of the language; and a detailed listing of discrepancies together with the tests which were failed.
Author (GRA)

N78-19829# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
PRELIMINARY DESIGN OF A PARTITIONABLE MULTI-MICROPROGRAMMABLE MICROPROCESSOR SYSTEM FOR IMAGE PROCESSING
Julius F. Bogdanowicz Nov. 1977 72 p refs
(Grants AF-AFOSR-2661-74; NSF ENG-76-18567)
(AD-A048839; TR-EE-77-42) Avail: NTIS HC A04/MF A01 CSCL 09/4

An approach to image processing hardware based on the concept of cellular logic arrays is first evaluated. A preliminary design of a partitionable multi-microprogrammable microprocessor system for image processing is then described. The performance of the multi-microprogrammable microprocessor system is also investigated. Author (GRA)

N78-19830# Rensselaer Polytechnic Inst., Troy, N. Y. Computer Research Lab.
AUTOMATIC DATA PROCESSING TECHNIQUES FOR GRAPHIC-DATA DISPLAY, GENERATION AND ANALYSIS Interim Report, 1 Sep. 1976 - 31 Aug. 1977
Herbert Freeman 31 Aug. 1977 24 p refs
(Contract AF-AFOSR-2937-76)
(AD-A049317; CRL-54; AFOSR-77-1298TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

This is an Interim Technical Report describing research carried out under Grant AFOSR 76-2937 during the 12-month period 1 September 1976 - 31 August 1977. The overall objective of the research program is to make significant improvements in the state of the art relating to the extraction, representation and computer interpretation of line drawing data. Specific tasks during the reporting year were concerned with (1) the reconstruction of solid-object descriptions from multiple photographic projections, (2) the development of programs for the removal of 'hidden lines' from the projection of both planar-faced and quadric-surface objects, (3) the design of a generalized chain coding scheme for the compact and precise description of map data, (4) the development of a line-drawing processing language, (5) an investigation into some new approaches to scale- and orientation-independent shape classification. Author (GRA)

N78-19831# RAND Corp., Santa Monica, Calif.
THE CRT TEXT EDITOR NED: INTRODUCTION AND REFERENCE MANUAL Interim Report
Walter Bilofsky Dec. 1977 59 p refs
(Contract DAHC15-73-C-0181; ARPA Order 189)
(AD-A049314; RAND/R-2176-ARPA) Avail: NTIS HC A04/MF A01 CSCL 05/8

A critical element in the use of computers to support document preparation, software development, and word processing is the interface between man and machine for the entry and modification of textual data files. In recent years, the cathode ray tube (CRT) terminal has grown more popular as an interface as it has become more sophisticated and less expensive. In most applications, the CRT terminal is used only to simulate line-at-a-time devices such as teletypes. However, this device is also capable of displaying textual documents in page form, and can alter its display rapidly enough to allow interactive text editing. Over the past few years Ned, a text editor utilizing the full capabilities of the CRT display, has been under development and in use at The Rand Corporation. The Ned editor runs on the PDP-11 series of computers under the UNIX operating system. It uses a CRT display to provide a two-dimensional window into a text file. The file may be altered by typing new material over the old. Lines, characters, and rectangular portions of text may be opened, deleted, and moved about, much as documents are edited with scissors and paste. Interactive text processing operations are provided, including paragraph fill, right-margin justification, and hyphenation. The set of operations may be expanded by user-provided or system-provided text-processing programs which are invoked interactively from within the Editor. The screen may be divided into several editing windows to simultaneously edit more than one file, or different portions of a file. GRA

N78-19832# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM OF AUTOMATIZING ENGINEERING WORK
Zygmunt Rychlicki and Lech Jarzebinski 25 Jul. 1977 15 p Transl. into ENGLISH from Biul. Inform. Inst. Lotnictwa (Poland), v. 13, no. 1, Jan. - Feb. 1976 p 16-18
(AD-A049068; FTD-ID(RS)T-1176-77) Avail: NTIS HC A02/MF A01 CSCL 09/2

The introduction of high-speed digital computers led to development of a method of engineering analysis based on iterative computation. GRA

N78-19833# Brookhaven National Lab., Upton, N. Y.
COMPUTER NETWORKS IN FUTURE ACCELERATOR CONTROL SYSTEMS

D. G. Dimmler Mar. 1977 17 p refs Presented at the 1977 Particle Accelerator Conf., Chicago, 16-18 Mar. 1977 Submitted for publication
(Contract EY-76-C-02-0016)
(BNL-22465) Avail: NTIS HC A02/MF A01

Results of a study concerning a computer based control and monitoring system are presented. Requirements for development and implementation of such a system are discussed. An architecture is proposed where the system components are partitioned along functional lines. Implementation of some conceptually significant components is reviewed. ERA

N78-19834# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.
A VISUAL SYSTEM MODEL AND A NEW DISTORTION MEASURE IN THE CONTEXT OF IMAGE PROCESSING Final Report
William A. Pearlman Jul. 1977 60 p refs
(Grant NSF ENG-75-10545)
(PB-274534/7; ECE-77-9) Avail: NTIS HC A04/MF A01 CSCL 09B

An error criterion for image processing is derived from a model of the visual system as a back of narrowband spatial filters. It is a Fourier-amplitude weighted squared error criterion reflecting the change in probability of detection and channel phases under a variation in image intensity. this new error criterion is compared to the common squared intensity error criterion in optimal linear filtering of images in additive noise. The restorations with the new criterion are more visually pleasing, more sharply detailed, and truer in contrast than those for ordinary squared error, and impressive in their own right. The mathematical properties of the new criterion suggest that significantly increased efficiency in the storage or communication of images may be gained by its use. GRA

N78-19780*# California Univ., Berkeley.
COMPUTING TECHNOLOGY IN THE 1980'S
Harold S. Stone *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 31-32 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19784*# Boeing Co., Seattle, Wash.
COMPUTATIONAL AERODYNAMICS REQUIREMENTS: THE FUTURE ROLE OF THE COMPUTER AND THE NEEDS OF THE AEROSPACE INDUSTRY
Paul E. Rubbert *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 81-90 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19788*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FUTURE REQUIREMENTS AND ROLES OF COMPUTERS IN AERODYNAMICS
Thomas J. Gregory *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 102-107 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19803*# Michigan Univ., Ann Arbor. Systems Engineering Lab.
A STUDY OF A MULTIPLE CRAY-1 FOR FLUID MECHANICS SIMULATION
D. A. Calahan, P. G. Buning, D. A. Orbits, and W. G. Ames *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 296-326 refs (For availability see N78-19778 10-59)
(Grant AF-AFOSR-2812-75)
(SEL-113) Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19805*# IBM Research Lab., San Jose, Calif.
MULTIPROCESSING TRADEOFFS AND THE WIND-TUNNEL SIMULATION PROBLEM
Tien Chi Chen *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 335-342 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19806*# Texas Instruments, Inc., Dallas.
TECHNOLOGY ADVANCES AND MARKET FORCES: THEIR IMPACT ON HIGH PERFORMANCE ARCHITECTURES
Dennis R. Best *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 343-353 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19807*# Institute for Advanced Computation, Sunnyvale, Calif.
GIGAFLOP ARCHITECTURE, A HARDWARE PERSPECTIVE
Gary F. Feierbach *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 354-362 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19808*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SINGLE USER EFFICIENCY MEASURE FOR EVALUATION OF PARALLEL OR PIPELINE COMPUTER ARCHITECTURES
W. P. Jones *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 363-371 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19809*# SRI International Corp., Menlo Park, Calif.
THE INDIRECT BINARY N-CUBE ARRAY
Marshall Pease *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1977 p 372-380 refs (For availability see N78-19778 10-59)
(Grant NSF GJ-42696)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19810*# California Univ., Los Angeles. Center for Plasma Physics and Fusion Engineering.
METHODOLOGY OF MODELING AND MEASURING COMPUTER ARCHITECTURES FOR PLASMA SIMULATIONS
Li-ping Thomas Wang *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1977 p 381-393 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 05B

N78-19812*# Institute for Advanced Computation, Sunnyvale, Calif.
A HIGH LEVEL LANGUAGE FOR A HIGH PERFORMANCE COMPUTER
R. H. Perrott *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 409-417 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19814*# Institute for Advanced Computation, Sunnyvale, Calif.
SPECIALIZED COMPUTER ARCHITECTURES FOR COMPUTATIONAL AERODYNAMICS
David K. Stevenson *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 423-428 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19815*# California Inst. of Tech., Pasadena.
SUGGESTED ARCHITECTURE FOR A SPECIALIZED FLUID DYNAMICS COMPUTER
Bengt Fornberg *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 429-434 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19816*# SRI International Corp., Menlo Park, Calif.
MICROPROCESSOR ARRAYS FOR LARGE SCALE COMPUTATION
William H. Kautz *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 435-445 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19817*# RAND Corp., Santa Monica, Calif.
FEASIBILITY OF A SPECIAL-PURPOSE COMPUTER TO SOLVE THE NAVIER-STOKES EQUATIONS
E. C. Gritton, W. S. King, I. Sutherland, R. S. Gaines, C. Gazley, Jr., C. Grosch, M. Juncosa, and H. Petersen *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 446-456 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19818*# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
A MODULAR MINICOMPUTER BASED NAVIER-STOKES SOLVER
John Steinhoff *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 457-470 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19819*# Aerospace Corp., Los Angeles, Calif.
COMPUTATIONAL ADVANCES IN FLUID DYNAMICS
T. D. Taylor *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 471-483 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N78-19835 California Univ., Berkeley.
THE GEOMETRY OF EFFICIENT RETRIEVAL ALGORITHMS Ph.D. Thesis
Azad Bolour 1977 120 p
Avail: Univ. Microfilms Order No. 77-31296

The difficulty of answering a query from a file that is partitioned into a number of buckets under the action of a hashing function is measured by the number of buckets that must be searched in order to answer that query. The overall effectiveness of a hashing algorithm is then taken to be an appropriate average of this number, in which queries whose descriptions are similar in terms of a Boolean combination of range statements are given equal weight. It is shown that efficient balanced hashing functions in this context often include hashing functions that partition the universe of records into multi-dimensional boxes. When hashing functions considered are restricted to show some degree of randomness, a corresponding efficient partition of the universe of records is often composed of parts that may best be described as scattered boxes. These are lattice-like structures in which the elements of a lattice are dispoint, identical boxes.
Dissert. Abstr.

N78-19836 Northwestern Univ., Evanston, Ill.
A SPECIAL PURPOSE MULTIPROCESSOR FOR THE SIMULATION OF DYNAMIC SYSTEMS Ph.D. Thesis
William Lloyd Hatcher, III 1977 182 p
Avail: Univ. Microfilms Order No. 77-32310

Many of todays systems are prohibitively expensive to simulate with the required accuracy. It was felt that the equations describing the system could be solved in parallel with savings in computer time. To this end the solution process was studied to find large scale (macro) parallelism. Macroparallelism was found both in the equations of the model and in the solution processes. Once this parallelism was found, requirements for and gains achievable by multiprocessors which use this inherent parallelism were developed. An efficient set of model equations was obtained by converting the differential equations to algebraic equations by the implicit multi- step integration formulas. The entire set of equations was then solved by an iterative algorithm.
Dissert. Abstr.

N78-19837 California Univ., Berkeley.
A PRACTICAL INTERPROCEDURAL DATA FLOW ANALYSIS ALGORITHM AND ITS APPLICATIONS Ph.D. Thesis
Jeffrey Michael Barth 1977 165 p
Avail: Univ. Microfilms Order No. 77-31278

A practical and efficient algorithm, applicable to a wide variety of programming languages, for computing the effects of subroutines on variables is presented. This information is called interprocedural data flow information. Computing interprocedural data flow information involves scanning through a program to record the effects of subroutines on variables and to determine the possible subcalling structure for each procedure. The techniques presented in this dissertation construct, in a single pass over the program, several relations which are easily computable independent of the order in which the program is scanned. These direct relations are then combined using transitive closure and relational composition in a manner which results in interprocedural data flow information. The algorithm has been implemented in Pascal to compute interprocedural data flow information for Pascal program.
Dissert. Abstr.

N78-19838 California Univ., Los Angeles.
THE THEORY OF RANDOM GRAPHS WITH APPLICATIONS TO THE PROBABILISTIC ANALYSIS OF OPTIMIZATION ALGORITHMS Ph.D. Thesis
Henry Koch Dewitt 1977 169 p
Avail: Univ. Microfilms Order No. 77-30901

The theory of random graphs (graphs where the edges are chosen randomly) is extended in the form of theorems useful to the analysis of average algorithm performance. Second, the basis for a theory of random Euclidean graphs is developed. Random Euclidean graphs occur when N points are randomly distributed in some plane region and pairs are connected if less than a prescribed distance R apart. They are particularly important as a more accurate model of common applications than are abstract random graphs. The theories of random graphs and random Euclidean graphs are applied to the probabilistic analysis of the average performance of several optimal graph algorithms.
Dissert. Abstr.

N78-19839 Cornell Univ., New York.
SYNTACTIC ERROR CORRECTION IN PROGRAMMING LANGUAGES Ph.D. Thesis
Kuo-chung Tai 1977 169 p
Avail: Univ. Microfilms Order No. 77-28415

A formal model for error correction using pattern mapping was developed, where a pattern describes how to map one string into another. The pattern mapping problem is formalized and its properties are explored. Using a preconstructed list of patterns, for each detected error, one finds the first pattern with successful mapping and makes a correction based on this pattern. A criterion for error correction is presented, which is to make minimum distance correction with k correct lookaheads. That is, we require k correct lookahead symbols for correction to insure that no spurious error follows immediately, and select the one which has minimum distance among corrections with k correct lookaheads.
Dissert. Abstr.

N78-19840# Naval Underwater Systems Center, New London, Conn. Special Projects Dept.
FORTRAN PROGRAM FOR LINEAR PREDICTIVE SPECTRAL ANALYSIS OF UNIVARIATE COMPLEX DATA WITH DISJOINT EQUI-SIZED PIECES
Albert H. Nuttall 12 Dec. 1977 21 p refs
(ZR00001)
(AD-A048279; NUSC-TD-5831) Avail: NTIS HC A02/MF A01 CSCL 09/2

A FORTRAN program for linear predictive spectral analysis of univariate complex data with disjoint equi-sized pieces is presented. This result has application to data taken with a device that periodically goes off-line, and to maximum entropy beamforming on a limited number of equi-spaced linear array elements.
Author (GRA)

N78-19841# School of Aerospace Medicine, Brooks AFB, Tex.
GENERAL PURPOSE DATA CONVERSION PROGRAMS FOR THE PDP-12 COMPUTER Final Report, Jan. 1976 - Jan. 1977
Kenneth W. Stevens Nov. 1977 94 p
(AD-A049043; SAM-TR-77-25) Avail: NTIS HC A05/MF A01 CSCL 09/2

An analog-digital conversion program has been written for the PDP-12 computer. A time code tape search unit has been interfaced with the computer to provide program control of an analog tape transport. A coordinated digital-analog program provides tape duplication, tape monitoring, and mapping of the digitized data. Author (GRA)

N78-19842# TRW Defense and Space Systems Group, Redondo Beach, Calif.
SMITE REFERENCE MANUAL
Nov. 1977 217 p refs
(Contract F30602-77-C-0089)
(AD-A049038; TRW-30417-6002-RU-00; RADC-TR-77-364)
Avail: NTIS HC A10/MF A01 CSCL 09/2

This is a reference manual for the use of SMITE which is a high level hardware description language used to describe various computer hardware architectures and then to generate an emulation of these architectures on the Nanodata QM-1 microprogrammable computer. Author (GRA)

N78-19843# Ohio State Univ., Columbus. Computer and Information Science Research Center.
DBC SOFTWARE REQUIREMENT FOR SUPPORTING RELATIONAL DATABASES
Jayanta Banerjee and David K. Hsiao Nov. 1977 88 p refs
(Contract N00014-75-C-0573)
(AD-A049180; OSU-CISRC-TR-77-7) Avail: NTIS HC A05/MF A01 CSCL 05/2

This is the final report of a series of work aimed at demonstrating the capabilities of a back-end database computer (DBC) in supporting known data models and systems. In the previous two reports, it was shown that existing hierarchical and network database management systems, in particular, the Information Management System (IMS) of IBM and DMS1100 of UNIVAC, can be supported on the DBC with a vastly improved performance. In this final report, we study a relational database management system, namely System R, with a view to supporting such a system on the DBC. The early sections of this report are introductory in nature. The representation of relational tuples in the DBC is quite straightforward. The data items of every tuple are converted to attribute-value pairs to form a single DBC record. Two special attribute-value pairs are also included in each DBC record in order to indicate the relation to which the corresponding tuple belongs, and to provide certain clustering information. User transactions in the data sublanguage, called SEQUEL, are converted to a series of DBC commands. The commands are so structured that the DBC can simultaneously access a number of records, the contents of which satisfy the predicates in a SEQUEL query. Given a particular command, the DBC uses its directory to determine the portions of its secondary storage that need to be content-searched. GRA

N78-19844# Carnegie-Mellon Univ., Pittsburgh, Pa.
BENDERS'S METHOD REVISITED
Egon Balas and Christian Bergthaller May 1977 28 p
(Contract N00014-75-C-0621; NSF MPS-73-08534)
(AD-A048887; MSRR-401; WP-42-76-77) Avail: NTIS HC A03/MF A01 CSCL 12/1

The master problem in Benders's partitioning method is an integer program with a very large number of constraints, each of which is usually generated by solving the integer program with the constraints generated earlier. Computational experience shows that the subset B of those constraints of the master problem that are satisfied with equality at the linear programming optimum often play a crucial role in determining the integer optimum, in the sense that only a few of the remaining inequalities are needed. We characterize this subset B of inequalities. Though the best upper bound (often attained) on the cardinality of B is 2 to the P power, where p is the number of integer-constrained variables that are basic at the linear programming optimum, none of the inequalities in B is implied by the remaining inequalities of the master problem. We then give an efficient procedure for generating an appropriate subset of the inequalities in B, which leads to a considerably improved version of Benders's method. Author (GRA)

N78-19845# Harry Diamond Labs., Adelphi, Md.
BDACS SOFTWARE
John C. Ingram Nov. 1977 127 p refs
(Contract MIPR-76628)
(AD-A049303; HDL-TR-1831) Avail: NTIS HC A07/MF A01 CSCL 09/2

The Binary Data Acquisition and Control System (BDACS) has undergone extensive hardware augmentation to provide additional high-speed and low-speed monitoring. In a parallel effort, the software control package for the BDACS has undergone a similar major modification to provide the necessary control functions for the extended hardware. Moreover, the restructed software package has incorporated improvements in data acquisition and reduction efficiency and has provided a more detailed on-line printout of the data vector. Last, the new BDACS software package has been organized in a structured program modular format to allow for future expansion without complicated interdependencies among the several program modules. Author (GRA)

N78-19846# Goodyear Aerospace Corp., Akron, Ohio.
PRECISION STARAN CORRELATOR Final Technical Report, Oct. 1976 - Jun. 1977
T. E. Gorsica and L. D. Stoner 1 Jun. 1977 40 p refs
(Contract DAAK70-76-C-0247)
(AD-A049308; GER-16464; ETL-0133) Avail: NTIS HC A03/MF A01 CSCL 17/9

This report describes a digital image area correlation computer program written for the U.S. Army Engineering Topographic Laboratories CDC-6400 and Staran computers. Its purpose is to predict the strength and positional registration of the correlation of two input images: (1) a live image taken from flight tests of the U.S. Army Pershing II missile terminal guidance system; (2) a reference image for use with the above guidance system. Author (GRA)

N78-19847# Office of Telecommunications, Boulder, Colo.
COMPUTER SOFTWARE FOR EWCS PERFORMANCE PREDICTION
E. J. Dutton Aug. 1976 96 p refs
(AD-A049211; OT-76-225) Avail: NTIS HC A05/MF A01 CSCL 17/2

A computer program in FORTRAN IV language entitled PROGRAM PREDIC has been prepared. This calculates performance prediction and its 5 and 95 percent confidence levels for microwave terrestrial links (8 to 30 GHz) operating in the European Wideband Communication System (EWCS). This program predicts atmospheric attenuation, principally due to rain, at the indicated frequencies. Author (GRA)

N78-19848# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
AN EMBEDDING RESULT FOR LABELLED PROGRAMS
Richard A. Demillo and S. Rao Kosaraju Jun. 1977 15 p refs
(Grants DAAG29-76-G-0338; NSF DCR-75-09904)
(AD-A049344; GIT-ICS-77/09; ARO-14690.2-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

It is shown that structured programs with n-1 labels can be simulated by structured programs with n labels by increasing the running time of the programs by at most a factor of 4. Two versions of this result are proved and in one version no node splitting operations are required in performing the simulation. Author (GRA)

N78-19849# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
NOISEMAP COMPUTER PROGRAM OPERATOR MANUAL. ADDENDUM FOR VERSION 3.4 OF NOISEMAP
Nicolaas Reddingius Wright-Patterson AFB, Ohio AMRL Dec. 1977 14 p
(Contract F33615-76-C-0507)
(AD-A049070; AMRL-TR-77-75-Add) Avail: NTIS HC A02/MF A01 CSCL 09/2

NOISEMAP is a computerized procedure for predicting contours of equal noise exposure around airbases. It is routinely used to aid airbase planners to prevent community encroachment limiting the aircraft operational effectiveness of installations and for conducting environmental noise assessment studies. This technical memorandum describes the four new features incorpo-

rated into version 3.4 of the NOISEMAP program. These are new sideline noise exposure algorithm, estimation of maximum allowed cutoff for computation, estimation of grid spacing on the basis of runway utilization, additions to the GPCP interface to make Compatible Use District Maps in the preferred format for USAF AICUZ analyses. Author (GRA)

N78-19850# General Electric Co., Sunnyvale, Calif.
FACTORS IN SOFTWARE QUALITY. VOLUME 1: CONCEPTS AND DEFINITIONS OF SOFTWARE QUALITY Final Technical Report, Aug. 1976 - Jul. 1977
Jim A. McCall, Paul K. Richards, and Gene F. Walters Griffiss AFB, N.Y. RADC Nov. 1977 168 p refs 3 Vol.
(Contract F30602-76-C-0417)
(AD-A049014; RADC-TR-77-369-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 09/2

This document is the final technical report (CDRL A003) for the Factors in Software Quality Study, contract number F30602-76-C-0417. The report consists of three volumes, as follows: Volume I Concept and Definitions of Software Quality, Volume II Metric Data Collection and Validation, Volume III Preliminary Handbook on Software Quality for an Acquisition Manager. The objective of the study was to establish a concept of software quality and provide an Air Force acquisition manager with a mechanism to quantitatively specify and measure the desired level of quality in a software product. Software metrics provide the mechanism for the quantitative specification and measurement of quality. This first volume describes the process of developing our concepts of software quality and what the underlying software attributes are that provide the quality, and defines the metrics which provide a measure of the degree to which the attributes exist. GRA

N78-19851# General Electric Co., Sunnyvale, Calif.
FACTORS IN SOFTWARE QUALITY. VOLUME 2: METRIC DATA COLLECTION AND VALIDATION Final Technical Report, Aug. 1976 - Jul. 1977
J. A. McCall, Paul K. Richards, and Gene F. Walters Griffiss AFB, N.Y. RADC Nov. 1977 155 p refs 3 Vol.
(Contract F30602-76-C-0417)
(AD-A049015; RADC-TR-77-369-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 09/2

The objective of the study was to establish a concept of software quality and provide an Air Force acquisition manager with a mechanism to quantitatively specify and measure the desired level of quality in a software product. Software metrics provide the mechanism for the quantitative specification and measurement of quality. This second volume describes the application of the metrics to software products and the validation of the metrics' relationship to software quality. GRA

N78-19852# General Electric Co., Sunnyvale, Calif.
FACTORS IN SOFTWARE QUALITY. VOLUME 3: PRELIMINARY HANDBOOK ON SOFTWARE QUALITY FOR AN ACQUISITION MANAGER Final Technical Report
Jim A. McCall, Paul K. Richards, and Gene F. Walters Griffiss AFB, N.Y. RADC Nov. 1977 42 p 3 Vol.
(Contract F30602-76-C-0417)
(AD-A049055; RADC-TR-77-369-Vol-3) Avail: NTIS HC A03/MF A01 CSCL 09/2

An hierarchical definition of factors affecting software quality was compiled after an extensive literature search. The definition covers the complete range of software development and is broken down into non-oriented and software-oriented characteristics. For the lowest level of the software-oriented factors, metrics were developed that would be independent of the programming language. These measurable criteria were collected and validated using actual Air Force data bases. A handbook was generated that will be useful to Air Force acquisition managers for specifying the overall quality of a software system. Author (GRA)

N78-19853# California Univ., Livermore. Lawrence Livermore Lab.
TRIX: AN INTERACTIVE, INTERPRETIVE LANGUAGE FOR MANIPULATING STRINGS OF CHARACTERS
Hank Moll 23 Dec. 1976 58 p refs Revised
(Contract W-7405-eng-48)
(UCID-30100-Rev-2) Avail: NTIS HC A04/MF A01

TRIX is a language for manipulating strings of characters. It consists of functions and a syntax for assembling these functions into named procedures called macros. A program written for the TRIX interpreter is called a dialect. The TRIX user writes a dialect by writing a series of macros as a disk file, and then reads-- in the dialect and executes the macros to carry out operations on a text file. Dialects run under TRIX are used for text editing, where text can be source code or English-language test. The basic TRIX functions, the TRIX syntax, and brief examples of macros are described in detail, showing applications to text-editing procedures. TRIX is an executable conrollee available on the CDC 8600 and 7600 computers of the Livermore time-sharing system. ERA

N78-19854# Los Alamos Scientific Lab., N. Mex.
SOME LINEAR ALGEBRAIC ALGORITHMS AND THEIR PERFORMANCE ON CRAY-1
Kirby Fong and Thomas L. Jordan Jun. 1977 18 p refs
(Contract W-7405-eng-36)
(LA-6774) Avail: NTIS HC A02/MF A01

Methods for achieving optimal performance were described and compared with more conventional methods. The various methods used to solve the following types of linear systems were analyzed; general linear systems by Gaussian elimination and Guass-Jordan methods, symmetric positive-definite systems by the root free Cholesky method, matrix inversion by the Guass-Jordan method, tridiagonal systems, least squares systems by the Householder transformation method, and both general banded systems and symmetric positive-definite banded systems. ERA

N78-19855# Sandia Labs., Albuquerque, N. Mex.
AUTOMATED EQUIPMENT MANAGEMENT SYSTEM FOR ORGANIZATION 9500
L. A. Faw Jun. 1977 128 p
(Contract EY-76-C-04-0789)
(SAND-77-0608) Avail: NTIS HC A07/MF A01

The automated equipment management system for Organization 9500 is a series of computer programs designed to perform the following functions: schedule several kinds of preventive maintenance on selected items of equipment, including electrical and mechanical tests, and adjustments; maintain an up-to-date repair and maintenance history of the items charged to the organization as required by ERDA regulations; and maintain an up-to-date file of data to supplement the data in the corporate inventory master file. This data is intended for management use in studies, special reports, budget requests, etc. It also provides a check for the data most likely to change in the corporate master file to insure accuracy through a feedback loop. The system is resident on the UNIVAC 1108 computer. It is in UNIVAC ANS COBOL. ERA

N78-19856# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
VARIATIONS ON A THEME BY HUFFMAN
Robert L. Gallager Dec. 1977 31 p refs Sponsored in part by Codex Corp.
(Grant NSF ENG-76-24447)
(PB-275036/2; ESL-P-787) Avail: NTIS HC A03/MF A01 CSCL 09D

Four new results about Huffman codes are presented. The first result shows that a binary prefix condition code is a Huffman code if the intermediate and terminal nodes in the code tree can be listed by nonincreasing probability so that each node in the list is adjacent to its sibling. The second result upper bounds the redundancy (expected length minus entropy) of a binary Huffman code by (P sub 1) + (log to the base 2)(2(log to the base 2)e)/e)=(P sub 1) + .086 where (P sub 1) is the probability of the most likely source letter. The third results shows that one can always leave a code word of length 2 unused and still have a redundancy of at most one. The fourth result is a simple algorithm for adapting a Huffman code to slowly varying estimates of the source probabilities. GRA

N78-19781*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THREE-DIMENSIONAL COMPUTATIONAL AERODYNAMICS IN THE 1960'S

Harvard Lomax *In its* Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 33-38 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19782*# Burroughs Corp., Paoli, Pa.
NUMERICAL AERODYNAMICS SIMULATION FACILITY PRELIMINARY STUDY, EXECUTIVE SUMMARY Final Report
In NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 41-62 (For availability see N78-19778 10-59)
(Contract NAS2-9456)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19783*# Control Data Corp., Minneapolis, Minn.
PRELIMINARY STUDY FOR A NUMERICAL AERODYNAMIC SIMULATION FACILITY Summary Report
N. R. Lincoln *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 63-79 (For availability see N78-19778 10-59)
(Contract NAS2-9457)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19785*# General Dynamics/Fort Worth, Tex.
REMARKS ON FUTURE COMPUTATIONAL AERODYNAMICS REQUIREMENTS
R. G. Bradley and I. C. Bhateley *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 91-101 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19787*# Lockheed-Georgia Co., Marietta.
PROJECTED ROLE OF ADVANCED COMPUTATIONAL AERODYNAMIC METHODS AT THE LOCKHEED-GEORGIA COMPANY
Manuel E. Lores *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 108-120 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19788*# ARO, Inc., Arnold Air Force Station, Tenn.
COMPUTATIONAL AERODYNAMICS REQUIREMENTS IN CONJUNCTION WITH EXPERIMENTAL FACILITIES
J. Leith Potter and John C. Adams *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 121-131 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19796*# Stanford Univ., Calif. Dept. of Mechanical Engineering.
LEVELS OF TURBULENCE PREDICTION
Joel H. Ferziger and Stephen J. Kline *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 229-238 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19798*# Boeing Military Airplane Development Seattle, Wash.
TURBULENCE MODELS FROM THE POINT OF VIEW OF AN INDUSTRIAL USER
S. F. Birch *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 248-259 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19800*# Mississippi State Univ., Mississippi State. Dept. of Aerophysics and Aerospace Engineering.
REMARKS ON BOUNDARY-FITTED COORDINATE SYSTEM GENERATION
Joe F. Thompson *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 267-277 refs (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19801*# Tennessee Univ., Knoxville.
FINITE ELEMENT CONCEPTS IN COMPUTATIONAL AERODYNAMICS
A. J. Baker *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 278-289 refs (For availability see N78-19778 10-59)
(Contract NAS1-14307; Grants NsG-1261; NsG-1391)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19802*# Boeing Aerospace Co., Seattle, Wash.
SOME MESH GENERATION REQUIREMENTS AND METHODS
Lawrence J. Dickson *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 290-294 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks.

N78-19857 California Univ., Los Angeles.
STREAM TRAFFIC COMMUNICATION IN PACKET SWITCHED NETWORKS Ph.D. Thesis
William Edward Naylor 1977 354 p
Avail: Univ. Microfilms Order No. 77-30948

Systems in which the communication channels are shared among many users, thus causing delay and capacity to vary were explored. The first area of concentration was an examination of some important factors which adversely affect delay in packet switched networks. The ARPANET was used as an example of such a network. We focus on loop control in adaptive routing, priority assignment, and the effect of periodic update routing in large networks. Even with improved performance, a packet switched network exhibits variable delay due in general to the possible queueing of packets at channels in the network. With stream traffic it is important to preserve the relative timing of the information as closely as possible. This accomplished by smoothing the departure of information with buffering. This was was the second main area of concentration. Dissert. Abstr.

N78-19858 Texas A&M Univ., College Station.
LOOP-FREE ADAPTIVE ROUTING PROCEDURES FOR DISTRIBUTED COMPUTER-COMMUNICATION NETWORKS Ph.D. Thesis
Charles Ernest Neblock 1977 217 p
Avail: Univ. Microfilms Order No. 77-32184

Algorithms are developed which provide a loop-free property for adaptive routing procedures utilizing periodic update techniques in distributed control computer-communication networks. The development was preceded by an investigation of network design principles and the characteristics of current adaptive routing algorithms. The techniques of queueing theory were utilized to develop a measure of expected system delay that could be used to compare the performance of routing algorithms and provide validation for a network simulation model. The simulating model was then developed and shown to provide surprisingly good results when compared with the theoretic predictions. Modifications to the algorithms were developed to eliminate message loss. Simulation of the modified algorithms indicated both were free from message loss and loop formation and provide substantially better message delay performance than the periodic update algorithm. Dissert. Abstr.

N78-19859# California Univ., Los Angeles. Graduate School of Management.
ON THE APPLICATION OF PEAK-LOAD PRICING TO COMPUTER SERVICES
Kweku Ewusi-Mensah and Bennet P. Lientz Dec. 1977 21 p refs
(Contract N00014-75-C-0266; NR Proj. 049-345)
(AD-A049297; TR-14) Avail: NTIS HC A02/MF A01 CSCL 17/2

Computer networks are increasing in usage and availability. Concurrently, individual centers are dealing with increased levels of usage and service demands during prime hours. A model for

addressing the peak load pricing problem for individual centers as well as networks is presented. The model is based on each center independently maximizing a specified objective function. Different price schedules are used for local and remote users over distinct time periods. Implementation of the model is discussed. Author (GRA)

N78-19804*# Colorado State Univ., Fort Collins. Computer Science Dept.
REVIEW OF THE AIR FORCE SUMMER STUDY PROGRAM ON THE INTEGRATION OF WIND TUNNELS AND COMPUTERS
Bernard W. Marschner *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 326-334 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19811*# R and D Associates, Marina Del Rey, Calif.
TOTAL SYSTEM ISSUES
John M. Levesque *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 395-403 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

N78-19813*# Boeing Computer Services, Inc., Seattle, Wash.
USER INTERFACE CONCERNS
David D. Redhed *In* NASA. Ames Res. Center Future Computer Requirements for Computational Aerodynamics Feb. 1978 p 418-422 (For availability see N78-19778 10-59)
Avail: NTIS HC A22/MF A01 CSCL 09B

63 CYBERNETICS

Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support.*

N78-19860 Syracuse Univ., N. Y.
THE STRUCTURE AND PROPERTIES OF CYCLIC CONVOLUTIONAL CODES Ph.D. Thesis
Pierre Alain VonKaenel 1977 100 p
Avail: Univ. Microfilms Order No. 77-30790

A decomposition theorem is given which leads to the definition of an equivalent encoder generated by one sequence. This implies that a cyclic convolutional code is a principal left ideal. Encoders defined as direct sums of certain minimal left ideals are examined, and general bounds on the free distance of the codes they generate are given. A criterion for a noncatastrophic encoder is given, and methods for designing noncatastrophic encoders whose codes have given bounds on the free distance are presented. In addition a new definition for a subclass of quasicyclic codes which are related to subsets of cyclic convolutional codes is presented, and constructive sounds on the minimum distance of certain quasicyclic codes are given. Dissert. Abstr.

N78-19861 West Virginia Univ., Morgantown.
A SIMULATION APPROACH FOR CODE MULTIPLEXED SYSTEMS Ph.D. Thesis
Sameh A. Mitry 1977 162 p
Avail: Univ. Microfilms Order No. 7732094

The feasibility of simulating code multiplexed systems was investigated. The research was limited to transmission of two signals modulated with their respective pseudonoise codes on a noiseless channel with arbitrary distortion characteristics. The code-demodulated signal is filtered to provide the output signal. A program was developed to generate and correlate pseudonoise codes. A method for simulating an arbitrarily shaped filter for modeling the system channel and components is developed. Programming techniques for simulating the total system are developed and typical simulation results are presented. The procedure used was dynamic simulation which describes samples of the signal values in time increments. The set of programs described provides a versatile aid in the design of a spread spectrum multiplex system. Dissert. Abstr.

N78-19862 Pennsylvania Univ., Philadelphia.
AN ALGEBRAIC MODEL OF ARITHMETIC CODES Ph.D. Thesis
Chung-Ho Chen 1977 108 p
Avail: Univ. Microfilms Order No. 77-30182

A theory of arithmetic codes covering the various aspects of code application is developed. In the existing arithmetic coding theory, the code structure is studied by using the properties of numbers. The concept of this dissertation is the treating of the set of computer binary numbers as a finite Abelien group and applying it to the study of arithmetic codes. Significant results are obtained which show that all arithmetic codes published to date are subclasses of a more general code class developed in this dissertation. Dissert. Abstr.

N78-19863 Massachusetts Univ., Amherst.
QUEUEING MODELS FOR DISTRIBUTED COMPUTER SYSTEMS Ph.D. Thesis
Yuan-chieh Chow 1977 158 p
Avail: Univ. Microfilms Order No. 77-30604

Workload balancing was achieved by using adaptive job scheduling policies. Examples were used to demonstrate that system performance as indicated by job turnaround time and throughput rate can be improved significantly by dynamically balancing the workload. Numerical solution techiques for the analysis of simple homogeneous and heterogeneous models were developed. The method of analysis for two processor models with well defined deterministic job routing strategies was shown to be dependent on special properties of the two dimensional state diagrams. An efficient recursive solution method for computing the state equilibrium probabilities was introduced for these cases. In other cases the Coxian staging method was used to derive the new job interarrival time distribution created by the job routing policy. Dissert. Abstr.

N78-19864# Naval Research Lab., Washington, D. C. Computer Science Lab.
EXPERIMENTS WITH SOME ALGORITHMS THAT FIND CENTRAL SOLUTIONS FOR PATTERN CLASSIFICATION Interim Report
James R. Slagle Sep. 1977 24 p refs
(AD-A049062; AD-E000050) Avail: NTIS HC A02/MF A01 CSCL 06/4

In two-class pattern recognition, it is a standard technique to have an algorithm for finding hyperplanes which separates the two classes in a linearly separable training set. The traditional methods find a hyperplane which separates all points in one class from all point in the other, but such a hyperplane is not necessarily centered in the empty space between the two classes. Since a central hyperplane does not favor one class or the other, it should have a lower error rate in classifying new points and is therefore better than a noncentral hyperplane. Six algorithms for finding central hyperplanes are tested on three data sets. Although frequently used in practice, the modified relaxation algorithm is very poor. Three algorithms, which are defined in the paper, are found to be quite good. Author (GRA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N78-19865 Connecticut Univ., Storrs.
OSCILLATORY AND ASYMPTOTIC BEHAVIOR OF SYSTEMS OF ORDINARY LINEAR DIFFERENTIAL EQUATIONS Ph.D. Thesis
Carl Henry Rasmussen 1977 105 p
Avail: Univ. Microfilms Order No. 77-31215

Conditions were established for oscillatory and asymptotic behavior for a reduced, first-order, matrix system of ordinary differential equations X prime= G(t)Y, Y prime= Q(t)X where G(t) and Q(t) are rectangular matrices of sizes r x n and n x r, respectively, with complex entries which are Lebesgue integrable on compact subsets of a real t-interval J =(a sub o, infinity).
Dissert. Abstr.

N78-19866 Ohio State Univ., Columbus.
A TWO-WAY ANALYSIS OF VARIANCE WITH POISSON RESPONSES Ph.D. Thesis
Edward Eugene Gbur, Jr. 1977 157 p
Avail: Univ. Microfilms Order No. 77-31873

An exact procedure is developed to analyze a two-way layout when the responses are counts having Poisson distributions. This procedure is based on a model selection approach rather than the normal theory analysis of variance idea of multiple hypothesis tests. Various statistical aspects of the procedure are investigated and a method of implementation is given along with several tables of necessary constants. A comparison of the behavior of the Poisson procedure with that of the F-statistics when the responses have Poisson distributions is included. The probability of correctly selecting the true model and the probabilities of four types of error which may occur were studied. For the particular situations studied, the Poisson procedure was better able to distinguish between the various models and to select the correct model than the F-statistics were.
Dissert. Abstr.

N78-19867 Pennsylvania Univ., Philadelphia.
AN EXTENDED VERSION OF DE BAKKER'S MUON-CALCULUS Ph.D. Thesis
Alexandru Pelin 1977 156 p
Avail: Univ. Microfilms Order No. 77-30240

A formal system for recursive procedures is presented in a simple programming language. A partial order is introduced on the set of statements in the language. A recursive procedure P is then interpreted as the minimal fixed of the transformation on the set of statement determined by the procedure body T(P). This approach was used to develop a formal system, the muon-calculus. The procedures considered make explicit use of memory and of assignment instructions. The axioms and rules of the muon-calculus are valid in the new version and some new axioms are added. The main questions treated are the equivalence problem and the use of memory by procedures. Some applications of the present version of the muon-calculus are included. Dissert. Abstr.

N78-19868*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONSERVATIVE IMPLICIT SCHEMES FOR THE FULL POTENTIAL EQUATION APPLIED TO TRANSONIC FLOWS
Terry L. Holst (Army Aviation R and D Command, Moffett Field, Calif.) and William F. Ballhaus Mar. 1978 37 p refs
(NASA-TM-78469; A-7338) Avail: NTIS HC A03/MF A01 CSCL 12A

Implicit approximate factorization techniques (AF) were investigated for the solution of matrix equations resulting from finite difference approximations to the full potential equation in conservation form. For transonic flows, an artificial viscosity, required to maintain stability in supersonic regions, was introduced by an upwind bias of the density. Two implicit AF procedures are presented and their convergence performance is compared with that of the standard transonic solution procedure, successive line overrelaxation (SLOR). Subcritical and supercritical test cases are considered. The results indicate that the AF schemes are substantially faster than SLOR. Author

N78-19869*# Douglas Aircraft Co., Inc., Santa Monica, Calif.
A SOLUTION TO THE SURFACE INTERSECTION PROBLEM Final Report
H. G. Timer 29 Nov. 1977 50 p
(Contract NAS2-9590)
(NASA-CR-152116; MDC-J7789) Avail: NTIS HC A03/MF A01 CSCL 12A

An application-independent geometric model within a data base framework should support the use of Boolean operators which allow the user to construct a complex model by appropriately combining a series of simple models. The use of these operators leads to the concept of implicitly and explicitly defined surfaces. With an explicitly defined model, the surface area may be computed by simply summing the surface areas of the bounding surfaces. For an implicitly defined model, the surface area computation must deal with active and inactive regions. Because the surface intersection problem involves four unknowns and its solution is a space curve, the parametric coordinates of each surface must be determined as a function of the arc length. Various subproblems involved in the general intersection problem are discussed, and the mathematical basis for their solution is presented along with a program written in FORTRAN IV for implementation on the IBM 370 TSO system. Author

N78-19870# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
APPLICATION OF TRIGONOMETRIC AND CONVENTIONAL FINITE DIFFERENCE APPROXIMATIONS TO BEAM BUCKLING M.S. Thesis
Steven Ray Hannah Dec. 1977 145 p refs
(AD-A048371; AFIT/GA/AA/77D-6) Avail: NTIS HC A07/MF A01 CSCL 12/1

A relatively new trigonometric approach to the finite difference calculus was applied to the problem of beam buckling as represented by both virtual work and equilibrium equations. The trigonometric functions were varied by adjusting a wave-length parameter in the approximating Fourier series. Values of the critical force obtained from the modified approach for beams with a variety of boundary conditions were compared to results using the conventional finite difference method. The trigonometric approach produced significantly more accurate approximations for the critical force than the conventional approach for a relatively wide range in values of the wavelength parameter; and the optimizing value of the wavelength parameter corresponded to the half wavelength of the buckled mode shape. It was found from a modal analysis that the most accurate solutions are obtained when the approximating function closely represents the actual displacement function. GRA

N78-19871# Aerospace Corp., El Segundo, Calif. Chemistry and Physical Lab.
NEW NUMERICAL METHODS APPLIED TO SOLVING THE ONE-DIMENSIONAL EIGENVALUE PROBLEM Interim Report
Bernard R. Johnson 14 Nov. 1977 37 p refs
(Contract F04701-77-C-0078)
(AD-A048446; TR-0078(3970-10)-1; SAMSO-TR-77-208)
Avail: NTIS HC A03/MF A01 CSCL 12/1

Two new numerical methods, the log derivative and the renormalized Numerov, are developed and applied to the calculation of bound-state solutions of the one-dimensional Schroedinger equation. They are efficient and stable; no convergence difficulties are encountered with double minimum potentials. A useful interpolation formula for calculating eigenfunctions at nongrid points is also derived. Results of example calculations are presented and discussed. Author (GRA)

N78-19872# Oak Ridge National Lab., Tenn. Computer Sciences Div.
MATHEMATICS AND STATISTICS RESEARCH DEPARTMENT Progress Report, period ending 30 Jun. 1977
W. E. Lever, comp., D. E. Shepherd, comp., R. C. Ward, comp., and D. G. Wilson, comp. Sep. 1977 80 p refs
(Contract W-7405-eng-26)
(ORNL-CSD-27) Avail: NTIS HC A05/MF A01

Brief descriptions are given of work done in mathematical and statistical research (moving-boundary problems; numerical analysis; continuum mechanics; matrices and other operators; experiment design; statistical testing; multivariate, multipopulation classification; statistical estimation) and statistical and mathematical collaboration (analytical chemistry, biological research, chemistry and physics research, energy research, engineering technology research, environmental sciences research, health physics research, materials research, sampling inspection and quality control, uranium resource evaluation research). Educational activities, publications and seminar titles are also included. ERA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N78-19873 California Univ., Berkeley.
COMULTIPLICATIVE FUNCTIONALS Ph.D. Thesis

Annibal Parracho SantAnna 1977 46 p
Avail: Univ. Microfilms Order No. 77-31525

Processes were constructed here by birthing a Markov process at a rate given by a comultiplicative functional in a dual sense of killing a Markov process with a multiplicative functional. Randomized comultiplicative functionals were then defined in such a way that a process birthed at a rate given by a randomized comultiplicative function was Markov conditionally on the knowledge of the comultiplicative functional chosen. Finally, the concept of exactness of comultiplicative functionals is discussed and a new correspondence between exact multiplicative and comultiplicative functionals is presented. Dissert. Abstr.

N78-19874 Northern Colorado Univ., Greeley.
AN INVESTIGATION OF TWO ASPECTS OF THE WALD-WOLFOWITZ RUNS TEST Ph.D. Thesis
Mary Sue Beersman 1977 63 p
Avail: Univ. Microfilms Order No. 77-30798

The use of a normal approximation for critical values was considered for sample sizes m and n, 20 < or equal to n < or equal to 50 and 5 < m or equal to n by multiples of 5. Monte Carlo simulations were used for this study. Two thousand simulations for each sample size pair when H sub 0: F sub 1 = F sub 2 was true provided data to check the use of a normal approximation for critical values. The results of the simulations when H sub 0: F sub 1 = F sub 2 was true indicated that the normal approximation yielded critical values such that actual significance levels were predicted to be less than or equal to the specified significance level when the standardization formula used involved a correction for continuity. Widely varying sample sizes had little effect on these results. Dissert. Abstr.

N78-19875 Florida State Univ., Tallahassee.
THE DIFFERENTIAL APPROACH IN STATISTICAL THEORY AND ROBUST INFERENCE Ph.D. Thesis
Dennis Dale Boos 1977 172 p
Avail: Univ. Microfilms Order No. 77-31021

Parameters of interest in statistics were expressed as functionals T(F) defined on distribution functions (d.f.'s). Such a representation expressed the relationship between the parameter as a numerical value and the d.f. generating the parameter. Evaluation of T as the sample d.f. F sub n yields an estimator T F sub n of the parameter T(F) having typically good properties provided that F sub n converges to F in a suitable stochastic sense. In fact, if the functional T possesed a differential at the point F (in the space of d.f.'s), then T F sub n - T(F) may be closely approximated by an average of random variables. Certain modifications, including stochastic versions of the differential, were introduced to broaden the scope of statistical application. Under suitable regularity conditions, the existence of a differential was seen to imply asymptotic normality. Dissert. Abstr.

N78-19876 Ohio State Univ., Columbus.
ESTIMATION THEORY OF SELECTIVE REPORTING, ORDERED PARAMETERS, AND SELECTION Ph.D. Thesis
Ishwari Dutt Dhariyal 1977 229 p
Avail: Univ. Microfilms Order No. 7731853

Procedures for point and interval estimation are given and the resulting estimators are compared with the corresponding estimators when all observations are available. For the problem of estimation of ordered parameters it is shown that if the distributions belong to the 1-parameter exponential family, then there does not exist an unbiased estimator for any ordered parameter. In the case of two normal populations, estimators of the larger mean are considered. Maximum probability estimators of ordered means are investigated numerically as regards their bias and mean squared error. A new class of estimators of the larger mean is introduced and investigated numerically. A comparison is also made among all available estimators derived from fixed sample size procedures, of the larger mean. Finally, the problem of joint selection and estimation is considered. For k normal populations with unknown means, procedures are developed which select the population associated with the largest mean and simultaneously estimate the largest mean by a confidence interval. Dissert. Abstr.

N78-19877 California Univ., Berkeley.
ROBUST MEASURES OF ASSOCIATION Ph.D. Thesis
Amy Poon Davis 1977 77 p
Avail: Univ. Microfilms Order No. 77-31331

Various robust definitions of measure of association between two random variables are considered. In all but the last chapter, the underlying distributions are assumed to be symmetric and the center of symmetry and measures of dispersion for the marginals are known. Various definitions of measure of association are judged by the asymptotic variances of their natural estimators. After an introduction to order of dependence and definition of measure of association, four classes of measures of association are introduced and studied. It is shown that none of the measures of association considered are uniformly better or worse than Pearson's correlation coefficient over the collection of all symmetric bivariate distributions. Next, robustness of a measure of association is defined and the robustness of the four classes of measures of association are studied. Finally, the asymptotic behavior of the estimators of measures of association are studied when the center of symmetry and measures of dispersion of the marginals are unknown. Dissert. Abstr.

N78-19878 Ohio State Univ., Columbus.
A k-SAMPLE WILCOXON RANK TEST FOR THE UMBRELLA ALTERNATIVES. 2: POINT OF THE UMBRELLA UNKNOWN Ph.D. Thesis
Gregory Allen Mack 1977 143 p
Avail: Univ. Microfilms Order No. 77-31927

A distribution free Wilcoxon rank test was proposed for the one way analysis of variance setting when a restricted alternative was of interest. This class of alternatives was referred to as umbrella alternatives. The limiting null distribution of the test statistic was obtained and was found to be expressible in terms of the multivariate normal integral. The consistency class of the test was derived and was shown to contain the entire class of umbrella alternatives provided certain mild restrictions on the sample sizes were satisfied. Asymptotic relative efficiencies with respect to an analogous normal theory competitor were given and a Monte Carlo power study was conducted to compare the proposed test against several other distribution free tests. Dissert. Abstr.

N78-19879 Northern Colorado Univ., Greeley.
SELECTION OF VARIABLES FOR REGRESSION USING FACTOR ANALYSIS Ph.D. Thesis
Michael John Mueller 1977 129 p
Avail: Univ. Microfilms Order No. 7730852

Rules for the selection of variables were developed and then tested via two experiments. The first experiment consisted of twenty-six variables on three factors. It was run for three different types of factor strength and four different values of common factor variance. The second experiment consisted of sixty variables on six factors which, from the lack of appreciable differences in the factor strengths, was run only for the four different values of common factor variance. The variables had variations of communality and complexity. The factor loadings were used to determine the correlation matrix of the variables and this was used to obtain the regression equations for each of the variables as functions of the remaining variables. The forward selection stepwise method was used to get the best predictors for a given size subset. The results of the experiments indicate that the communality of a variable is slightly more important than the complexity in determining the best predictors. Dissert. Abstr.

N78-19880 Oregon State Univ., Corvallis.
DENSITY ESTIMATION USING ORTHOGONAL SERIES: A BAYESIAN APPROACH Ph.D. Thesis
Patrick Craig Pointer 1978 194 p
Avail: Univ. Microfilms Order No. 77-32069

Assume that X sub 1, X sub 2,..., X sub n are i.i.d. observations from a distribution with a continuous density function f. Let X belong to the set (- infinity, infinity). The problem of forming an estimator of f(X) of the form class of all f sub n(x) + 1/n sum to n terms K sub n (x, X sub j) was approached from a Bayesian point of view. Dissert. Abstr.

N78-19881 Ohio State Univ., Columbus.
INFERENCE FOR THE GALTON-WATSON PROCESS Ph.D. Thesis
Randall Wayne Potter 1977 107 p

Avail: Univ. Microfilms Order No. 77-31956

A general technique was developed by which the asymptotic (zeta sub 0 approaches limit of infinity) distributions of estimators of the parameters may be obtained. The technique, which uses the asymptotic (zeta sub 0 approaches limit of infinity) joint distribution of the set of all offspring counts, was then applied to two special cases, a generalized binomial splitting model and a discrete uniform model, and comparisons were made between the asymptotic variances of competing estimators of mu (expected number of offspring per individual). Estimator of pi (probability of extinction of the process) was considered for three sampling plans: plan A, where one set of generation sizes was observed, plan B, where the complete set of offspring counts was observed, and plan C, where multiple sets of generation sizes were observed. Dissert. Abstr.

N78-19882 Ohio State Univ., Columbus.
DISTRIBUTION-FREE TEST FOR THE EQUALITY OF SEVERAL REGRESSION LINES Ph.D. Thesis
Theodore MacDonald Smith 1977 113 p
Avail: Univ. Microfilms Order No. 77-31985

For the problem of testing the equality of slope parameters from k linear regressions it is shown that any k-sample rank statistic for location based on the ranks of the modified residuals which incorporate a combined sample estimate of the common value of the slope will be distribution-free under the assumptions that both the dependent variable and independent variable are jointly distributed and that the intercepts from the k populations are equal. The consistency classes of a test based on the 2-sample Mann-Whitney-Wilcoxon rank statistic and the consistency classes of a test based on the k-sample Jonckheere rank statistic are presented. A Monte Carlo simulation study is presented comparing the power of the 2-sample Mann-Whiteny-Wilcoxon test statistic with the power of the least squares test statistic. Dissert. Abstr.

N78-19883 Syracuse Univ., N. Y.
THE MONTE CARLO SIMULATION STUDY OF MODEL VALIDATION BY LEAST SQUARES AND RIDGE REGRESSION METHODS Ph.D. Thesis
Bernard Yao-po Su 1977 148 p
Avail: Univ. Microfilms Order No. 7730765

A Monte Carlo simulation has been employed for this study. Several exogeneous variables are considered: (1) type of predictor variables (X fixed or X random), (2) number of predictor variables, (3) correlation coefficients between each pair of predictor variables, (4) parameter Beta vector (5) the size of error variance, and (6) the ratio of sample size to the number of predictor variables. For each combination of different values of all the exogeneous variables, 5000 replications were run. The results show the ridge estimators perform uniformly better than the least squares when Beta = Beta L, where Beta L represents the maximum axis of X prime X a mixed performance is observed. With Beta = Beta L, the three criteria were consistent with respect to the relative performance of the two estimators. With Beta = Beta S, they were found inconsistent in some situations. Dissert. Abstr.

N78-19884 Cornell Univ., Ithaca, N. Y.
SOME PROBLEMS IN SEQUENTIAL ESTIMATION Ph.D. Thesis
Yehuda Vardi 1977 93 p
Avail: Univ. Microfilms Order No. 7800093

Sequential analysis of three problems is presented. The first is a Homogeneous Poisson Process (HPP) and the problem of estimating its unknown intensity parameter, lambda (less than 0), is considered. A sequential procedure (Xi, X(Xi)/Xi) is derived whose risk function is uniformly (in Xi) smaller than 2(AXi) to the 1/2 power plus M, for some finite M. The second problem is a sequence of i.i.i.d.r.v.'s with density belonging to a Koopman Darmois family of distribution. One of the examples discussed is a sequential analogue of the phenomenon known (in the fixed sample size case) as a superefficient sequence of estimators. The third problem deals with an unknown number N of sources transmitting signals. Consideration is given to estimating N under several loss functions. Procedures whom have risk approximately equal to the risk of the best fixed stopping time are derived for the different loss functions. Confidence regions for N are also derived. Dissert. Abstr.

N78-19885 Ohio State Univ., Columbus.
BAYES ALLOCATION AND SEQUENTIAL ESTIMATION IN STRATIFIED POPULATIONS Ph.D. Thesis
Tommy Wright 1977 217 p
Avail: Univ. Microfilms Order No. 7732011

Bayesian optimal allocation for two cases - binomial strata and Poisson strata are considered. Independent beta prior distributions are assigned to the proportion parameters in the various strata and determine a Bayesian allocation of sample size with a cost constraint. A criterion for comparison of Bayesian allocation and Neyman allocation is given for the two cases. An intuitive notion for the quantity of information given by a prior distribution is presented from the allocation point of view. We introduce a truncated Bayesian sequential estimation procedure for stratified populations which is a generalization of the Bayesian sequential estimation procedure. A criterion is introduced for determining optimal order of selection and optimal allocation of the maximum sample to be taken. Numerical results are given for the binomial case with discussion. Dissert. Abstr.

N78-19886*# Houston Univ., Tex. Dept. of Mathematics.
LINEAR DIMENSION REDUCTION AND BAYES CLASSIFICATION
Henry P. Decell, Jr., P. L. Odell (Tex. Univ., Dallas), and William A. Coberly (Tulsa Univ.) Feb. 1978 9 p refs
(Contract NAS9-15000)
(NASA-CR-151652; Rept-66) Avail: NTIS HC A02/MF A01 CSCL 12A

An explicit expression for a compression matrix T of smallest possible left dimension K consistent with preserving the n variate normal Bayes assignment of X to a given one of a finite number of populations and the K variate Bayes assignment of TX to that population was developed. The Bayes population assignment of X and TX were shown to be equivalent for a compression matrix T explicitly calculated as a function of the means and covariances of the given populations. Author

N78-19887# Pittsburgh Univ., Pa. Dept. of Mathematics.
MULTIVARIATE IFRA DISTRIBUTIONS
Henry W. Block and Thomas H. Savits Jul. 1977 19 p refs
(Contract N00014-76-C-0839; Grant NSF MCS-77-01458)
(AD-A048438; RR-77-04) Avail: NTIS HC A02/MF A01 CSCL 12/1

A class of multivariate IFRA distributions is introduced. Properties of this class are studied and examples of distributions which are members of this class are given. Author (GRA)

N78-19888# University of Southern Calif., Los Angeles. International Relations Inst.
ADAPTIVE EXPONENTIAL SMOOTHING Supplement Report No. 1, 1 Oct. 1976 - 31 Jan. 1977
Frederick A. Rothe Nov. 1977 19 p refs Supplement to TR/A-TR-39
(Contract N00014-76-C-0137; ARPA Order 2518)
(AD-A049250; TR/A-TR-39) Avail: NTIS HC A02/MF A01 CSCL 12/1

The adaptive exponential smoothing technique, and its utility for international affairs analysis, is discussed. Both monitoring and forecasting aspects of the technique are described. Calculation procedures are illustrated and worked through in an example using international event/interaction data. Author (GRA)

N78-19889# North Carolina Univ., Chapel Hill. Dept. of Statistics.
SPLINE METHODS IN STATISTICS
Ian W. Wright 1977 47 p refs
(Grant AF-AFOSR-02840-75)
(AD-A049197; AFOSR-77-1307TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Spline functions are particularly appropriate in fitting a smooth non-parametric model. The use of spline functions in non-parametric density estimation and spectral estimation is surveyed. The requisite spline theory background is also included. Isotonic splines offer great promise in filtering noise from a smooth model with an order structure. Some results on the existence and several applications of general isotonic splines are given in the final section. Author (GRA)

N78-19890# Florida State Univ., Tallahassee. Dept. of Statistics.
G-ORDERED FUNCTIONS, WITH APPLICATIONS IN STATISTICS. 2: APPLICATIONS Interim Report
J. C. Conlon, R. Leon, F. Proschan, and J. Sethuraman Sep. 1977 27 p refs
(Grants AF-AFOSR-2581-74; DAAG29-76-G-0238)
(AD-A049316; FSU-STATISTICS-M433; AFOSR-77-1295TR)
Avail: NTIS HC A03/MF A01 CSCL 12/1

This is Part II of a two-part paper which continues the unification of stochastic comparisons. Many commonly used multivariate densities are shown to be G-ordered and, in fact, each density may be used as the kernel function in the integral transform for the preservation of G-monotonicity. We show that any elliptically-contoured density is G-ordered. An application of G-ordered functions to certain well known tests of a multivariate hypothesis is presented. Sufficient conditions on the distribution of the observations are determined so that the tests have G-monotone increasing power functions. GRA

N78-19891# Minnesota Univ., Minneapolis. Dept. of Theoretical Statistics.
NEAREST NEIGHBOR RULES FOR STATISTICAL CLASSIFICATION BASED ON RANKS
Somesh Das Gupta and Hsien Elsa Lin 5 May 1977 17 p refs
(Grant DAAG29-76-G-0038)
(AD-A049306; UMN/DTS/TR-285; ARO-13149.5-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

Some rank-based rules for classifying an observation into one of two populations, from which training samples are available, are suggested. The limiting values of their probabilities of misclassification are derived as the sizes of the training samples tend to infinity. The nearest neighbor idea is used in terms of ranks and two-sided neighbors to define the rank nearest neighbor rule. A multi-stage version is also suggested (in case of ties) and studied. Author (GRA)

N78-19892# Los Alamos Scientific Lab., N. Mex.
GAMMA PRIOR DISTRIBUTION SELECTION FOR BAYESIAN ANALYSIS OF FAILURE RATE AND RELIABILITY
R. A. Waller, M. M. Johnson, M. S. Waterman, and H. F. Martz, Jr. (Texas Tech. Univ.) Jul. 1976 36 p refs
(Contract W-7405-eng-36)
(LA-6879-MS) Avail: NTIS HC A03/MF A01

It is assumed that the phenomenon under study is such that the time-to-failure may be modeled by an exponential distribution with failure rate lambda. For Bayesian analyses of the assumed model, the family of gamma distributions provides conjugate prior models for lambda. The proposed methodology assumes that the practicing engineer can provide percentile data relating to either the failure rate or the reliability of the phenomenon being investigated. For example, the methodology will select the gamma prior distribution which conveys an engineer's belief that the failure rate lambda simultaneously satisfies the probability statements, P(lambda less than 0.001) equals 0.50 and P(lambda less than 0.00001)equals 0.05. That is, two percentiles provided by an engineer are used to determine a gamma prior model which agrees with the specified percentiles. ERA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N78-19893 California Univ., Berkeley.
ADAPTIVE DIGITAL MATCHED FILTERS Ph.D. Thesis
Uzi Zalk Padan 1977 157 p
Avail: Univ. Microfilms Order No. 7731491

Adaptive digital matched filters (DMF's) are analyzed within the broader context of the general adaptive M-ary receiver. Attention is focused on a single adaptive filter, for the case of L-chip-long binary signals and one-bit digitization of the received waveform. An optimal adaptive filter for the taught receiver is derived. The performance of this filter in terms of output signal-to-noise ratio (SNR), as a function of the number of transmissions of a training signal, is evaluated. A three-level adaptive taught DMF is analyzed and is shown to have a performance that is significantly closer to that of the optimal filter than the normal (two-level) adaptive DMF has. An untaught, self-adapting (decision-directed) DMF for the detection of a signal that is keyed on and off at random is described. A self-adapting DMF for two antipodal signals is also analyzed. Dissert. Abstr.

N78-19894 Texas Technological Univ., Lubbock.
INTERDISCIPLINARY PROBLEM SOLVING AND THE SYNTHESIS OF COMPLEX SYSTEMS Ph.D. Thesis
Gary Brent Wood 1977 119 p
Avail: Univ. Microfilms Order No. 7731171

A discussion on the current views of solution synthesis for complex interdisciplinary problems is presented and a systematic synthesis method is developed. The conceptual boundaries are designed to preclude consideration of the actual cognitive process of the human problem solver and to focus on augmenting and improving human problem solving capacity. The dissertation endeavors to provide a structured way to handle complex problems which are not adaptable to individual disciplines or uncoordinated multidisciplinary efforts. The four fundamental issues of problem solving are developed. The philosophy of problem solving is developed as the interrelationship of three powerful algorithmic procedures. A formal metalanguage is presented. The language pervades the development of concepts and issues and is demonstrated in an example problem. Dissert. Abstr.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N78-19895 Emory Univ., Atlanta, Ga.
FUNCTIONAL EQUATIONS IN LINEAR SPACES Ph.D. Thesis
Dickenson Moore Taliaferro 1977 70 p
Avail: Univ. Microfilms Order No. 7732392

The following three functional equations were examined. (1) f(x + ny) + (n-1)/Sigma (i=0) b sub i (y)f(x+iy) = 0, (2) f(x + y) = n/Sigma/(i=0) b sub i (y)f sub i (x), and (3) f sub i (x + ny) +(n-l)/Sigma/i=0 b sub i(y)f sub i (x + iy) = 0. Each equation was assumed to hold for all x, y in a linear space, each unknown f sub i had its final set in some linear space over the complex field, and each b sub i was complex valued. Dissert. Abstr.

N78-19896 Texas Technological Univ., Lubbock.
RANDOM VARIABLES, WEINER-HOPF FILTERING AND CONTROL FORMULATED IN ABSTRACT SPACES Ph.D. Thesis
Leonard Jeng Tung 1977 76 p
Avail: Univ. Microfilms Order No. 77-31168

By working with a Banach resolution space, in which operator properties such as causality, left- and right-miniphase, maxiphase were defined, theories of operator factorization were developed. These theories were then applied to Banach space valued random variables. Hilbert space valued random variables, scattering operators and Wiener-Hopf filtering. Dissert. Abstr.

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

No abstracts in this category.

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N78-19897 Connecticut Univ., Storrs.
MATRIX OPTIMIZATION OF ULTRASONIC ARRAYS Ph.D. Thesis
James Preston Waters 1977 183 p
Avail: Univ. Microfilms Order No. 7731233

Matrix formulations are developed for optimizing field patterns from ultrasonic transducer arrays. The approach is general and is applicable both in the near and far fields of a wide variety of ultrasonic arrays. The theory can be applied to arrays which operate in either a CW or pulse mode, have arbitrary geometry and possess elements which are either point or extended sources of ultrasonic radiation. The theory takes into account phase, amplitude and element spacing as part of the parametric optimization procedure. Parts of the theory presented are verified using computer simulation techniques, and by experimental measurements. Results show that the theory can provide substantial improvement in the field patterns, thereby eliminating the need for intuitive or trial and error techniques. Dissert. Abstr.

N78-19898*# National Aeronautics and Space Administration. Pasadena Office, Calif.
RESOLUTION ENHANCED SOUND DETECTING APPARATUS Patent Application
James M. Kendall, inventor (to NASA) (JPL) Filed 16 Dec. 1977 10 p
(Contract NAS7-100)
(NASA-Case-NPO-14134-1; US-Patent-Appl-SN-861392) Avail: NTIS HC A02/MF A01 CSCL 20A

The acuity of an acoustic mirror and microphone system is increased in order to precisely detect the location of a noise source, such as that created by an airframe in a wind tunnel, or by machinery. The apparatus which includes mirror which reflects sound from a source to a microphone, can be shifted until the noise detected by microphone is loudest, to determine the precise location from which the sound originates. An enclosure is positioned around the mirror and is filled with a heavy gas such as Freon. The sound waves move slower in the heavy gas than in air, so the wavelength of sound waves is shorter, and the mirror can more accurately focus the sound waves onto the microphone. A pair of thin sheets in front of the mirror is pressed apart by slightly pressured air between them so that all light rays pass perpendicular to the interface between the air in front of the wall and the Freon gas behind wall and are not refracted by the Freon gas. NASA

N78-19899*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Dept.
EVALUATION OF THE IN-FLIGHT NOISE SIGNATURE OF A 32-CHUTE SUPPRESSOR NOZZLE: ACOUSTIC DATA REPORT
M. T. Moore and V. L. Doyle Nov. 1977 438 p refs
(Contract NAS2-9312)
(NASA-CR-152076) Avail: NTIS HC A19/MF A01 CSCL 20A

Outdoor static and 40 x 80 FT wind tunnel tests of the J79-15 engine/nacelle system with the conic nozzle and 32-chute exhaust suppressor were conducted to acquire the data necessary to evaluate the simulated in-flight signature of an engine-size 32-chute exhaust nozzle suppressor using the 40 x 80 ft wind tunnel and to study possible engine core noise contamination of the jet signature. The tests are described and and a sampling of the data acquired is presented. Included are aero performance summaries, as-measured and composite 1/3 OBSPL spectra for the 70 ft sideline high and low mics from the outdoor static tests, sideline traverse spectra and internal noise measurements from both the outdoor static and the 40 x 80 ft wind tunnel tests. Author

N78-19900# Catholic Univ. of America, Washington, D. C. Dept. of Mechanical Engineering.
INTRODUCTION TO WIENER-HOPF METHODS IN ACOUSTICS AND VIBRATION
David G. Crighton Dec. 1977 91 p refs
(Contract N00167-76-M-8415)
(AD-A048766; DTNSRDC-77-0112) Avail: NTIS HC A05/MF A01 CSCL 20/1

The Wiener-Hopf technique is now firmly established as a powerful tool for research in certain types of boundary value problem arising in acoustics. Typical problems which may be solved exactly or asymptotically with this technique concern the sound and vibration levels generated by finite or semi-infinite planar or cylindrical surfaces, of local or extended reaction, immersed in a compressible fluid and subject to acoustic or mechanical forcing. However, even the simplest of these problems involves complications which are irrelevant to an understanding of the Wiener-Hopf method itself and its various extensions. Accordingly, this report was written in an attempt to display the operation of the technique in an even simpler physical and mathematical context, and thereby to encourage its more widespread use. The report deals with the application of Wiener-Hopf methods to one-dimensional wave motions on strings and beams, and in particular with the reflection and transmission from discontinuities in the mechanical properties of a string. Also included is a section illustrating how a generalized Wiener-Hopf problem can be set up for a three-part problem involving a string of finite length. Two dimensional wave problems are then exemplified in a discussion of the acoustic field generated by a vibrating half-plane, and the effect of uniform mean flow over the half-plane is included to show how different types of 'edge condition' may be accommodated. GRA

N78-19901# California Univ., Los Angeles. Dept. of Physics.
NON-LINEAR PARAMETRIC GENERATION OF SOUND BY RESONANT MODE CONVERSION Interim Report
Steven Lurie Garrett Dec. 1977 201 p refs
(Contract N00014-75-C-0246)
(AD-A049157; TR-39) Avail: NTIS HC A10/MF A01 CSCL 20/1

When non-linear terms are included in the two fluid hydrodynamic description of superfluid helium-4, first sound and second sound are coupled. The interaction of two second sound waves to produce a propagating first sound wave is shown to occur at a specific angle which makes the point of intersection of the second sound waves travel at the speed of first sound. An experiment to observe this mode conversion process in a waveguide of rectangular cross-section is described. Measurements show that the resonant conversion occurs at the theoretically predicted frequency. The amplitude of the mode converted first sound is found to exhibit a quadratic dependence on the amplitude of the primary wave which is characteristic of a second order effect. A new application of the reciprocity calibration technique allowed an absolute calibration of the pressure microphones in situ. Absolute measurements of the coupling of first sound to second sound agree with theory. This agreement is a direct confirmation of the importance of the additional, intrinsically non-linear, Galilean invariant variable, in the thermohydrodynamics of superfluid helium. The theoretical formalism is applied to the parametric amplification of second sound by high intensity first sound and the results are in disagreement with a previous calculation by Khokhlov and Pushkina. Author (GRA)

N78-19902# Naval Research Lab., Washington, D. C.
AN ACOUSTIC TRANSPONDER FOR CALIBRATING ULTRASONIC EQUIPMENT Final Report
Henry H. Chaskelis Oct. 1977 14 p ref
(AD-A049178; AD-E000091; NRL-MR-3552) Avail: NTIS HC A02/MF A01 CSCL 17/1

Effective inspection of structural materials by ultrasonic techniques requires that the acoustically detected anomalies be properly displayed with respect to time (depth location) and amplitude. This requirement is particularly important when interpolating the flaw signal from a reference standard or when making periodic reinspections of known flaws. In order to verify such accuracy in the ultrasonic equipment, an electronically controlled acoustic transponder has been developed and built to Navy specifications. This device is used to verify the time and amplitude linearity, resolution capability and dB attenuator accuracy of conventional ultrasonic equipment, either in the field

or in the laboratory. If required, the accuracy of this device may be made traceable to the Bureau of Standards. Author (GRA)

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N78-19903 Yale Univ., New Haven, Conn.
MEASUREMENTS OF TOTAL SCATTERING CROSS SECTION FOR VARIOUS COLLISION PARTNERS Ph.D. Thesis
Hsuan Lillian Tien 1977 138 p
Avail: Univ. Microfilms Order No. 77-28169

Absolute values of total elastic cross sections were determined for argon scattered by 30 different aliphatic hydrocarbons, N2, O2, CO2, He and H2 at a relative velocity 555m/s. From these cross sections, the so-called van dar Waals C6 coefficients were determined for the attractive portions of the intermolecular potentials. Independent scattering measurements with 38 of these pairs indicated that the mixing rule values in general were within less than 5 percent of the experimental values. In addition C6 values calculated by the Slater-Kirkwood approximation were also found to be generally within about 5 percent of the experimental values except for hydrogen-hydrocarbon systems. A simple model was found to be effective in correcting the Slater-Kirkwood approximation for cases in which the molecular dimensions were an appreciable fraction of the internuclear distances.
Dissert. Abstr.

N78-19904 Georgia Inst. of Tech., Atlanta.
THE EFFECT OF DIODE AND ARRAY GEOMETRICAL PARAMETERS ON PERFORMANCE OF HIGH FIELD ELECTRON EMITTERS FORMED FROM UNIDIRECTIONALLY SOLIDIFIED URANIUM DIOXIDE-TUNGSTEN COMPOSITES Ph.D. Thesis
Wayne Laurance Ohlinger 1977 198 p
Avail: Univ. Microfilms Order No. 77-29216

The capabilities of UO2-W composites applied as multi-pin field emission cathodes were assessed to evaluate the effects of variation of certain geometrical diode and array parameters on emission performance, and to compare the experimentally demonstrated capabilities with theoretical predictions. The effects of anode-cathode geometry on emission performance were assessed, particularly the means by which diode design can influence the uniformity of the emission from the cathode. The value of the field enhancement factor for the arrays was quantitatively determined as a function of interelectrode spacing, pin tip radius, and pin packing density. The maximum macroscopic current density obtainable from the arrays is reported and compared with a realistic model developed on the basis of the experimental results. Several possible reasons for failing to reach the predicted performance levels are discussed, and the probable mechanism of failure which limits the achievable current density is described. Dissert. Abstr.

N78-19905 Connecticut Univ., Storrs.
IONIZATION AND INELASTIC ENERGY LOSS MEASUREMENTS OF INNER-SHELL EXCITATIONS IN Kr (+)-Kr AND Kr(+) - Xe COLLISIONS Ph.D. Thesis
Ali Abdel-Ghany Antar 1977 133 p
Avail: Univ. Microfilms Order No. 77-31054

The final charge states of the scattered ions and the inelastic energy loss were measured for single collisions of MeV Kr ions with Kr and Xe targets. The charge states of the scattered ions were measured as functions of scattering angle for 0.25, 0.4, 0.6, and 1.0 MeV collision energies for Kr(x) - Kr and 0.4, 0.6, and 1.0 MeV collision energies for Kr(x) - Xe. The total inelastic energy loss of both Kr(x) - Kr and Kr(x) - Xe systems were measured for 0.4, 0.6 and 1.0 MeV collision energies, using the scattered recoil particle coincidence technique. The results show the dependence of inner shell excitations on the collisions' distance of closest approach, R sub 0. The data confirm the quasimolecular nature of heavy ion-atom collisions within the framework of Fano-Lichten model. Dissert. Abstr.

N78-19906 California Inst. of Tech., Pasadena.
QUANTUM MECHANICAL STUDIES OF MOLECULAR SCATTERING Ph.D. Thesis
John Patrick Dwyer 1978 284 p
Avail: Univ. Microfilms Order No. 7732567

A collection of seven theoretical studies on elementary chemical processes is presented. In each of the studies a quantum mechanical framework to describe a particular chemical system is used. A model that describes energy transfer in the collinear collision of two diatomic molecules is examined. The importance of low energy reaction probabilities in calculating low temperature rate constants was studied. A survey of resonances in the reactive scattering of collinear H + H2 and its symmetric isotope variants is presented. The effects of barrier height on vibrational deactivation in collinear scattering were studied. A method is proposed to describe collinear breakup collisions of the form A + BC yields A + B + C comparison of two independent calculations of reactive scattering in an actual chemical system is discussed. The difficulty of doing exact quantum calculations for even simple reactive systems is considered along with mathematical approximation that preserves the accuracy of the exact results. Dissert. Abstr.

N78-19907*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATOMIC HYDROGEN STORAGE METHOD AND APPARATUS Patent Application
John A. Woolam, inventor to (NASA) Filed 29 Sep. 1977 10 p
(NASA-Case-LEW-12081-2; US-Patent-Appl-SN-837794) Avail: NTIS HC A02/MF A01 CSCL 20H

Atomic hydrogen, for use as a fuel or as an explosive, is stored in the presence of a strong magnetic field in exfoliated layered compounds such as molybdenum disulfide or an elemental layer material such as graphite. The compound is maintained at liquid helium temperatures and the atomic hydrogen is collected on the surfaces of the layered compound which are exposed during delamination (exfoliation). The strong magnetic field and the low temperature combine to prevent the atoms of hydrogen from recombining to form molecules. NASA

N78-19908# Aerodyne Research, Inc., Bedford, Mass.
MEASUREMENTS OF NITRIC OXIDE ION VIBRATIONAL ABSORPTION COEFFICIENT AND VIBRATIONAL TRANSFER TO N2
Fritz Bien Sep. 1977 53 p refs
(Contract F19628-76-C-0178; AFGL-TR-77-0181; SR-1)
(AD-A048628; ARI-RR-110.1) Avail: NTIS HC A04/MF A01 CSCL 20/8

The line locations absorption coefficient and quenching of NO(+) vibration in the v = 1 and v = 2 by N2 have been experimentally determined. Integrated absorption coefficients corrected for a thermal equilibrium distribution are: S sub lu(1 - 2 P15) = 420/sq cm/atm at 2291.63/cm and S sub lu(2 - 3 R2) = 653/sq cm/atm at 2286.72/cm. Quenching of NO(+)(v) by N2 at 297 K was found to give rates of k = 2.4 times 10 to the -12 power cu cm/sec for NO(+)(v = 2) and k = 3.0 times 10 to the -12th power/cu cm/atm for NO(+)(v = 1). An estimate of 3 times 10 to the -13th power cu cm/sec was found for quenching of NO(+)(v = 2) by NO at 297 K.
Author (GRA)

N78-19909# Arizona Univ., Tucson. Optical Sciences Center.
EFFECT OF MOLECULAR ROTATION ON VIBRATIONAL RELAXATION Final Report
D. N. Rogovin, M. O. Scully, and F. A. Hopf Aug. 1977 26 p refs
(Contract F29601-74-A-0023)
(AD-A049064; AFWL-TR-76-49) Avail: NTIS HC A03/MF A01 CSCL 20/8

This final report studies the effect of molecular rotation on vibrational relaxation. A model for complicated vibrational collisions is developed. Changes in the molecular rotation are of significant importance in vibration collision processes and dominate deactivation processes at thermal velocities. GRA

N78-19910# Sandia Labs., Albuquerque, N. Mex.
NEUTRON DIAGNOSTIC SYSTEM FOR PARTICLE BEAM

FUSION EXPERIMENTS
J. J. Ramirez, L. W. Kruse, and R. J. Leeper Jun. 1977 29 p refs
(Contract EY-76-C-04-0789)
(SAND-77-0916) Avail: NTIS HC A03/MF A01

This system consists of three major components: (1) time resolving neutron counters; (2) neutron threshold activation detectors; and (3) the total neutron yield monitors. These three components when taken together enable a thorough description of target produced neutrons. In particular, the system is capable of giving an indication of the neutron spectrum produced, the total number of neutrons produced, and the neutron formation time. The system is designed to maintain a high overall detection efficiency. A novel feature of the system is the use of gated photomultiplier tubes capable of operating in the presence of the intense bremsstrahlung background characteristics of electron and some ion beam experiments. Author (ERA)

N78-19911# Los Alamos Scientific Lab., N. Mex. Theoretical Div.
SELF-CONSISTENT FIELD MODEL FOR CONDENSED MATTER
David A. Liberman 1977 12 p refs Presented at Intern. Conf. on Phys. of Transition Metals, Toronto, 15-19 Aug. 1977
(Contract W-7405-eng-36)
(LA-UR-77-1595; Conf-770827-2) Avail: NTIS HC A02/MF A01

A model for condensed matter is described in which the ions surrounding a particular atom are replaced by a constant density positive charge background outside of a spherical cavity. Electrons provide sufficient negative charge to neutralize the atomic nucleus at the center of the cavity and the positive charge outside. The orbital functions of the electrons, both bound and free, are obtained as solutions of the Dirac equation and are used to self-consistently determine the potential function. A prescription is given for separating the total volume and the total free energy of the system into parts associated with the atom and the surrounding medium. The Wigner-Seitz sphere radius at which the atomic free energy is lowest was found for each of 14 elements including the 5d transition metals. They differ from the sphere radii based on measured densities from 2 to 8 percent. ERA

N78-19912# Brookhaven National Lab., Upton, N. Y.
EFFECT OF NEUTRON IRRADIATION ON SINGLE CRYSTAL V3Si
R. Viswanathan, R. Caton, D. E. Cox, A. Guha (City College of CUNY, New York, N.Y.), M. P. Sarachik (City College of CUNY, New York, N.Y.), F. W. Smith (City College of CUNY, New York, N.Y.), and L. R. Testardi (Bell Telephone Lab., Murray Hill, N.J.) 1977 13 p refs Presented at the Intern. Discussion Meeting of Radiation Effects in Superconductors, Argonne, Ill., 13 Jun. 1977
(Contract EY-76-C-02-0016)
(BNL-23015; Conf-770649-5) Avail: NTIS HC A02/MF A01

The effect of successive neutron irradiation up to a fluence of approximately 2 x 10 to the 19th power n/sq cm was investigated by measurements of heat capacity, susceptibility, resistivity, acoustic velocity and neutron diffraction in a single crystal V3Si for low level doses (phi t greater than or equal to 3.5 x 10 to the 18th power n/sq cm) (a) the structural transformation is very sensitive, whereas the suerconducting transition temperature, T/sub c/, is hardly affected, and (b) except for low temperature heat capacity, most of the other measurements show very little change. For the highest fluence of 2 x 10 to the 19th power n/sq cm used to date, the T/sub c/ dropped to 7.5 K with large changes in the linear heat capacity coefficient, magnetic susceptibility and sound velocity. ERA

N78-19913# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
EXCITATION AND IONIZATION OF IONS BY ELECTRON IMPACT Technical Progress Report, 1 Sep. 1976 - 31 May 1977
R. K. Feeney, D. W. Baggett, D. W. Hughes, G. W. Rivers, and W. E. Sayle 31 May 1977 36 p refs
(Contract EY-76-S-05-3027)
(ORO-3027-38) Avail: NTIS HC A03/MF A01

The current tasks of measuring electron impact excitation and ionization cross sections include: (1) the completion of absolute measurements of the electron impact double ionization cross sections for Na(x), K(x), Rb(x), Cs(x), and Tl(x) ions; (2) the development of a laboratory size ion source of multiple charged ions to be used in the measurement of electron impact excitation and ionization cross sections; and (3) the completion of absolute measurements of the electron impact excitation of Li(x) ions. Measurements were made over the range of electron energies from the respective threshold values to approximately 1000 eV. Spectroscopic techniques verified the production of ions of charge state C(4x) when CO2 was used as the source gas. ERA

N78-19914# North Carolina State Univ., Raleigh. Dept. of Nuclear Engineering.
CESIUM HEAT-PIPE NEUTRAL PARTICLE SPECTROMETER M.S. Thesis
David A. Brisson 1977 76 p refs
(Contract W-7405-eng-26)
(TID-27705) Avail: NTIS HC A05/MF A01

The energy spectra of neutral particles escaping a magnetically confined plasma were examined using electron capture collisions in a cesium charge exchange heat pipe to attain conversion efficiencies more than two orders of magnitude greater than previously used stripping analyzers for neutral energies below 200 eV. Efficiency curves for the cesium heat pipe were obtained experimentally for hydrogen and deuterium using a Coulutron ion beam system. Cesium loss rates were measured with a surface ionization gauge. Neutral hydrogen energy measurements were made on the ELMO Bumpy Torus, a toroidal mirror machine. These neutral energy spectra were unfolded to obtain ion temperatures for several plasma conditions. The ion temperatures obtained with the cesium heat pipe energy analyzer corresponded well to previous temperature measurements made with an N2 stripping analyzer. ERA

N78-19915# California Univ., Livermore. Lawrence Livermore Lab.
MULTIPHOTON SPECTROSCOPY IN HEAVY ELEMENTS
R. W. Solarz, J. A. Paisner, and E. F. Worden 3 May 1977 12 p refs Presented at the Intern. Conf. on Multiphoton Processes, Rochester, N. Y., 6-9 Jun. 1977
(Contract W-7405-eng-48)
(UCRL-79470; Conf-770653-1; IS-77-123) Avail: NTIS HC A02/MF A01

Some recently discovered regularities in the spectra of heavy elements which are also applicable to the analysis of the spectra of lighter atoms are described. Stepwise resonant multiphoton methods are irreplaceable tools in the study of high lying states in a complex atomic system. Systematic applications of these methods have permitted regularities to be observed which also hold for the lighter elements. It is noted that greatly increased understanding of the excited state structure of heavy atoms is not possible. ERA

N78-19916# California Univ., Livermore. Lawrence Livermore Lab.
ROLE OF SPACE CHARGE IN BEAM TRANSPORT
J. E. Osher 25 Mar. 1977 14 p Presented at Intern. Conf. on Low Energy Ion Beams, Salford, UK, 5 Sep. 1977
(Contract W-7405-eng-48)
(UCRL-79311; Conf-770949) Avail: NTIS HC A04/MF A01

Beam-current criteria for divergence from space charge are recent theoretical models for fractional space-charge neutralization are derived and recent theoretical models for practional space-charge neutralization are reviewed. Space-charge-related observations on ion-beam transport in a specific experimental system are discussed as well as several applications using space charge. Experimental measurements of effective space charge are for a dc ion-source test stand using a 90 deg double-focusing magnet for species separation and for a solenoidal lens magnet for focus of the ion beam preparatory to entrance into a 400-kV accelerator column. ERA

N78-19917# Argonne National Lab., Ill.
ORIENTATION OF FAST IONS EXCITED IN SURFACE COLLISIONS
H. G. Berry, G. Gabrielse, and A. E. Livingston 1977 17 p

refs Presented at the 3rd Intern. Conf. on Ion Beam Anal., Washington, D.C., 27 Jun. - 1 Jul. 1977 Prepared in cooperation with Chicago Univ.
(Contract W-31-109-eng-38)
(CONF-770642-11) Avail: NTIS HC A02/MF A01

The grazing angle scattering of fast heavy ions from copper and gold surfaces was investigated by measuring the angular distribution of the scattered ions distribution and observing the states of polarization of light emitted from excited states of the scattered ions. The polarization is strongly dependent on the angle of scattering, and evidence was shown that the atomic orientation depends principally upon the exit grazing angle. The surface collision mechanisms were discussed. ERA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N78-19918 Syracuse Univ., N. Y.
GEOMETRIC MODELS OF HADRONS Ph.D. Thesis
Robert Henry Andreo 1977 170 p
Avail: Univ. Microfilms Order No. 7730707

The nature of the gauge group of the free massless string and the relevance of gauge conditions for a consistent quantization scheme are carefully examined and clarified. To enable these models to confront experiment, a procedure for constructing the eigenvectors and determining the physical subspace was developed and applied to some low-lying states and trajectories. The classical solutions of the string in one spatial dimension are studied in detail. A string-type model with massive quarks is presented. The questions of spin and unitary symmetry were addressed by studying the spectrum of a model derived from the SLAC bag. The single compelling assumption present throughout these investigations is Poincare invariance. The requirement effectively specifies the form of gauge conditions, the nature of the quantization scheme, and the positive-definiteness of the physical subspace without necessity of restrictions on spacetime dimensions or other artifices of any kind. Dissert. Abstr.

N78-19919 College of William and Mary, Williamsburg, Va.
MEASUREMENT OF RADIATIVE MUON CAPTURE IN CALCIUM Ph.D. Thesis
Richard Dennis Hart 1977 105 p
Avail: Univ. Microfilms Order No. 7731785

Approximately 1200 background subtracted photons of energies greater than or equal to 63.5 MeV emanating from the capture of precessing muons by a proton in a calcium nucleus were observed. From the precession frequency of the muon spin, a value of +0.90 plus or minus 0.50 for the radiative capture photon momentum-muon spin asymmetry was extracted. The photon energy distribution is consistent with an integrated branching ratio of radiative to normal muon capture above 57 MeV of (21.1 plus or minus 0.06) x 10 to the -6 power.
Dissert. Abstr.

N78-19920* National Aeronautics and Space Administration, Washington, D. C.
NON-EQUILIBRIUM RADIATION NUCLEAR REACTOR Patent
Karlheinz Thom and Richard T. Schneider, inventors (to NASA) (Fla. Univ., Gainesville) Issued 21 Feb. 1978 8 p Filed 21 Mar. 1975 Supersedes N75-22108 (13 - 13, p 1574)
(NASA-Case-HQN-10841-1; US-Patent-4,075,057; US-Patent-Appl-SN-560891; US-Patent-Class-176-39; US-Patent-Class-330-4.3) Avail: US Patent Office CSCL 18K

An externally moderated thermal nuclear reactor is disclosed which is designed to provide output power in the form of electromagnetic radiation. The reactor is a gaseous fueled nuclear cavity reactor device which can operate over wide ranges of temperature and pressure, and which includes the capability of processing and recycling waste products such as long-lived transuranium actinides. The primary output of the device may be in the form of coherent radiation, so that the reactor may be utilized as a self-critical nuclear pumped laser.
Official Gazette of the U.S. Patent Office

N78-19921# Los Alamos Scientific Lab., N. Mex.
REACTOR TECHNOLOGY FOR SPACE ELECTRICAL POWER (10 TO 100 kWe)
David Burden Aug. 1977 25 p refs
(Contract W-7405-eng-36)
(LA-6891-MS) Avail: NTIS HC A02/MF A01

Various reactor power plants are studied for space applications in the range of 10 to 100 kWe to meet space missions in the late 1980's and 1990's. The study is concentrating on a high-temperature, compact, fast reactor that could be coupled with various radiation shielding systems and thermoelectric, thermionic, or dynamic electrical power conversion systems, depending on the mission. Though the study is continuing, this report provides a description of what a typical power plant might contain in the time period and at the power levels of interest.
ERA

N78-19922# Northwestern Univ., Evanston, Ill. Dept. of Computer Sciences.
EXACT AND APPROXIMATE INTERIOR CORNER PROBLEM IN NEUTRON DIFFUSION BY INTEGRAL TRANSFORM METHODS
E. H. Bareiss, K. S. J. Chang, and D. A. Constatinescu Sep. 1976 307 p refs
(Contract EY-76-S-02-2280)
(COO-2280-28) Avail: NTIS HC A14/MF A01

The mathematical solution of the neutron diffusion equation exhibits singularities in its derivatives at material corners. A mathematical treatment of the nature of these singularities and its impact on coarse network approximation methods in computational work is presented. The mathematical behavior is deduced from Green's functions, based on a generalized theory for two space dimensions, and the resulting systems of integral equations, as well as from the Kontorovich-Lebedev transform. The effect on numerical calculations is demonstrated for finite difference and finite element methods for a two-region corner problem. ERA

74 OPTICS

Includes light phenomena.

N78-19923 Purdue Univ., Lafayette, Ind.
SECOND HARMONIC EFFECTS IN COUPLED SEMICONDUCTOR-PIEZOELECTRIC DEVICES AND THEIR APPLICATIONS TO OPTICAL IMAGING Ph.D. Thesis
Richard Wayne Myers 1977 223 p
Avail: Univ. Microfilms Order No. 77-30113

The three major second harmonic effects caused by the presence of charge carriers in coupled semiconductor-piezoelectric devices, second harmonic surface acoustic wave generation, transverse convolution and longitudinal convolution, were considered. Experimental results are presented for second harmonic surface wave generation and transverse convolution. The applications of second harmonic effect devices to acoustic optical imaging are discussed. A procedure is given which is used to determine the linear Rayleigh wave propagation solution in lithium niobate when a semiconductor is in close proximity to the propagation surface. The computer implementation of this provides an accurate basis from which second harmonic effects may be considered. Dissert. Abstr.

N78-19924 Texas A&M Univ., College Station.
THE SCATTERING OF SUNLIGHT IN THE ATMOSPHERE-OCEAN SYSTEM: A STUDY USING MONTE CARLO TECHNIQUES Ph.D. Thesis
John Alonzo Guinn, Jr. 1977 159 p
Avail: Univ. Microfilms Order No. 7732162

Separate Monte Carlo programs are developed to evaluate the distribution of scattered light in the earth's atmosphere-ocean system. In one case the radiance, the degree and direction of

polarization, and the ellipticity are calculated, using a flat-ocean model, for the radiation at various optical depths in the atmosphere and the ocean. In the other case radiances are calculated for a model which includes ocean waves. In each case absorption and all orders of multiple scattering by hydrosols and aerosols as well as by Rayleigh scattering centers are taken into account. Complete single-scattering phase matrices are used for the calculation of the polarization quantities, which are given as functions of ocean turbidity, the solar zenith angle, and the wavelength of the radiation. Mie theory is used to compute the phase matrices for the aerosols and hydrosols, which are assumed to have appropriate particle-size distributions. Reflection and refraction at the air-water interface are fully considered.
Dissert. Abstr.

N78-19925 California Univ., Berkeley.
NEMATIC AND CHOLESTERIC LIQUID CRYSTAL DEVICES FOR INTEGRATED OPTICS Ph.D. Thesis
Young Se Kwon 1977 121 p
Avail: Univ. Microfilms Order No. 7731431

For the application in an optical waveguide, the electric field effects of a room-temperature nematic liquid crystal, MBBA (N 4 prime-methoxybenzylidene-4-n-butylaniline), were studied. The electric field effects on the weakly cholestric liquid crystal obtained by mixing MBBA with a small quantity of a cholesteric liquid crystal, cholesteryl nonanoate, was also observed with the electric field applied in the transverse direction, i.e., parallel to the liquid crystal film. An optical waveguide with MBBA as a waveguiding film was constructed with a propagation loss of about 15 db/cm for the guided beam 100% modulation of the guided beam with the response time of the order of tens of milliseconds was achieved. Dissert. Abstr.

N78-19926 Pennsylvania Univ., Philadelphia.
ANGLE-RESOLVED PHOTOEMISSION STUDY OF CHALCOGEN ORDERED OVERLAYERS Ph.D. Thesis
Stephen Phillip Weeks 1977 290 p
Avail: Univ. Microfilms Order No. 77-30267

The chemisorption of well-ordered overlayers of sulfur, selenium, and tellurium (chalcogens) on a clean, (100)-oriented single-crystal nickel surface was studied using angle-resolved ultraviolet photoemission spectroscopy (ARUPS). The angular dependence of photoemission from p(2x2) and c(2x2) sulfur and selenium overlayers for 21.2 eV photons, and from p(2x2) and c(2x2) tellurium for 16.8 eV photons, was measured using a movable small-aperture retarding field analyzer, with light at a fixed angle of incidence relative to the crystal. The dependence of emission from sulfur, selenium, and tellurium on light incidence angle was measured by moving the collector and sample simultaneously, holding the collection angle fixed, and varying only the incidence angle. Preliminary measurements of the dependence of emission from c(2x2)S-Ni(100) on photon energy using synchrotron radiation are also reported. Dissert. Abstr.

N78-19927*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
DEVELOPMENT OF BIREFRINGENT FILTERS FOR SPACEFLIGHT
Alan M. Title, Thomas P. Pope, Harry E. Ramsey, and Steven A. Schoolman Jul. 1976 48 p
(Contract NAS5-22368)
(NASA-CR-156674) Avail: NTIS HC A03/MF A01 CSCL 20F

The critical problem for flight of a birefringent filter is the shock mounting of the calcite. The design presented here bonds the calcite block with silicon rubbers to the calcite holder. The calcite together with its all necessary polarizers and rotating achromatic plates are mounted together in units called a filter module. By using a set of modules containing calcite crystals of differing lengths, a filter can be produced. A description of the modules is given. Also described is a container for the filter modules, which can be used both to hermetically seal the system or contain an index matching oil. The response of a filter element while being controlled by the Lockheed Temperature Control is described and the determination of the wavelength sensitivity to temperature of calcite is explained. Operation of the filter using a software control algorithm instead of a hardware temperature controller is shown. Some radiation considerations of filter systems are given. Author

N78-19928*# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
THE 100 MICRON DETECTOR DEVELOPMENT PROGRAM
W. J. Moore Mar. 1976 50 p refs
(Contract NAS2-8706)
(NASA-CR-137892; CRSR-642) Avail: NTIS HC A03/MF A01 CSCL 20F

An effort to optimize gallium-doped germanium photoconductors (Ge:Ga) for use in space for sensitive detection of far infrared radiation in the 100 micron region is described as well as the development of cryogenic apparatus capable of calibrating detectors under low background conditions. Author

N78-19929# Catholic Univ. of America, Washington, D. C. Vitreous State Lab.
DEVELOPMENT OF A LOW LOSS OPTICAL FIBER WITH A PARABOLIC PROFILE Final Report, 1 Sep. 1976 - 30 Apr. 1977
R. K. Mohr, P. B. Macedo, and T. A. Litovitz Nov. 1977 67 p refs
(Contracts N00019-76-C-0674; N00019-76-C-0083)
(AD-A049168) Avail: NTIS HC A04/MF A01 CSCL 20/6

The objective of this contract was to develop the technique of Molecular Stuffing to produce low-loss parabolic index optical fibers. The concluding work under these contracts consisted of the following: Put into operation experimental profiling procedures to test the theory developed; institute a program for the measurement and characterization of measured index profiles in preforms and fibers in order to determine the modifications needed in the part above; measure physical properties of cesium nitrate solutions for a precise control of unstuffing bath concentration and its variation in time; and measurement of attenuation, dispersion, bending and scattering losses in our fibers.
Author (GRA)

N78-19930# Northrop Corp., Anaheim, Calif. Electro-Mechanical Div.
EXPERIMENTAL DEVELOPMENT OF A FLIR SENSOR PROCESSOR
T. Leiboff, H. Henning, T. Noda, and B. Deal 30 Sep. 1977 210 p
(Contract DAAG53-76-C-0188)
(AD-A049323; NORT-77Y196) Avail: NTIS HC A10/MF A01 CSCL 17/5

Contents: Auto Focus Experiments; Auto Deblur Experiments; Edge Enhancement Experiments; Adaptive Signal Processing; Bandwidth Compression; Image Descriptors; Sensor Processor Unit - Demonstration Prototype; and Autofocus Demonstration.
GRA

N78-19931# Naval Ocean Systems Center, San Diego, Calif.
EVALUATION OF MULTIPORT FIBER-OPTIC BUNDLE COUPLERS Test and Evaluation Report, 1 Jul. 1976 - 30 Sep. 1977
D. E. Altman and T. A. Meador 28 Oct. 1977 24 p refs
(AD-A049268; NOSC/TR-171) Avail: NTIS HC A02/MF A01 CSCL 17/2

Development and evaluation of fiber-optic coupling devices are discussed. Author (GRA)

N78-19932# RAND Corp., Santa Monica, Calif.
REMOTE ACQUISITION OF GROUND TARGETS THROUGH IMAGE CORRELATION MAP-MATCHING
H. H. Bailey Mar. 1977 34 p refs Presented at the Airpower Symp., Maxwell AFB, Ala., 30 Mar. 1977
(AD-A049111; RAND/P-58) Avail: NTIS HC A03/MF A01 CSCL 17/8

A class of weapon guidance based on a technique known as map-matching or image correlation has potential importance in the near future for both strategic and tactical applications in which accurate weapon delivery from standoff is required. The paper presents a brief tutorial explanation of the nature of this guidance technique, discusses both its strengths and its weaknesses, and describes some current research on the

acquisition phase (the avoidance of gross errors) in image correlation. Author (GRA)

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N78-19933 Cornell Univ., Ithaca, N. Y.
THEORETICAL PROBLEMS IN PLASMA HEATING Ph.D. Thesis
Thomas Marbory Antonsen, Jr. 1977 149 p
Avail: Univ. Microfilms Order No. 7800064

The production of intense ion beams which may be used in a variety of heating schemes was presented. The characteristics of two ion producing devices were examined. In each case the steady state dependence of the electron and ion current densities on accelerating voltage was found. The main result of the analysis was that the efficiency of production of intense ion beams can be substantially greater than predicted by simple theory. Several problems involving the propagation and collisionless absorption of lower hybrid waves were examined. In particular the nonlinear effect of large amplitude waves on electron Landau damping and the detailed description of lower hybrid wave propagation near ion cyclotron harmonic surfaces were determined. Finally, the energy transport and heating by lower hybrid waves in a Tokamak was simulated on a computer. Dissert. Abstr.

N78-19934 California Univ., Berkeley.
THE DRIFT CONE INSTABILITY: WARM PLASMA STABILIZATION AND RADIAL NORMAL MODE ANALYSIS Ph.D. Thesis
Michael Jonathan Gerver 1977 238 p
Avail: Univ. Microfilms Order No. 77-31366

The electrostatic flute-like normal modes were found for a collisionless loss cone plasma in a uniform magnetic field with density varying sinusoidally in one direction in space. A local method and a nonlocal method were used. Parameters included the density ratio of warm to hot plasma, the temperature ratio, the density gradient, the mirror ratio of the hot plasma, and the density of hot plasma. Seven different regimes of the parameter space were found, including a usual drift cone instability regime, a two-temperature instability regime, and a drift cyclotron instability regime. The principal new result was that all flute instabilities were suppressed by a warm component which only filled in a small part of the loss cone. Dissert. Abstr.

N78-19935 College of William and Mary, Williamsburg, Va.
CROSS FIELD CURRENT INSTABILITIES IN A VLASOV PLASMA Ph.D. Thesis
Don Stephen Lemons 1977 123 p
Avail: Univ. Microfilms Order No. 77-31787

The linear stability of an infinite inhomogeneous Vlasov plasma containing a current flowing perpendicular to a straight magnetic field is investigated. Time dependent solutions to the Vlasov-Maxwell equations are constructed to model a shock in which density and magnetic field gradients point in the same direction, and a sheath in which the magnetic field and density gradients point in opposite directions. These solutions are used as the zero order around which the equations are linearized. The linear equations imply a dispersion relation connecting the frequency, growth rate, and wavenumber of the first order perturbations. The full contribution of transverse fields is included in the dispersion relation and arbitrary direction of wave propagation in the plane formed by the direction of the magnetic field and the current is allowed. The dispersion relation is solved numerically for a variety of limiting cases as well as for the shock and sheath configurations. Dissert. Abstr.

N78-19936 Cornell Univ., Ithaca, N. Y.
THE EFFECT OF CONDUCTING WALLS AND A PREIONIZED PLASMA COLUMN ON ELECTRON BEAM TRAJECTORIES IN LINEAR AND TOROIDAL GEOMETRY Ph.D. Thesis
Thomas Ramsbeck Lockner 1977 226 p
Avail: Univ. Microfilms Order No. 78-00102

The trajectories for a relativistic electron beam propagating between a plasma column and conducting vacuum vessel are calculated theoretically and vertified experimentally. Both linear and toroidal geometries are considered. Injection into both linear and toroidal sectors with an aluminum rod on the axis (modeling the plasma) verify the guiding center trajectories found theoretically. A method is developed for determining the beam position and net current using three magnetic probes and a Rogowski in a plane perpendicular to the minor axis. Evidence of the effect of the trajectory on the beam propagation in the preionized Cornell Racetrack Experiment is shown. Dissert. Abstr.

N78-19937 California Univ., Los Angeles.
NEGATIVE ION PLASMAS-CONFINEMENT OF TOROIDAL PLASMA CURRENTS BY SURFACE MAGNETIC FIELDS Ph.D. Thesis
Dean Leo Mamas 1977 89 p
Avail: Univ. Microfilms Order No. 7730937

Experimental results in the areas of waves and instabilities, and experimental fusion-oriented devices are presented. An experiment conducted upon a plasma composed of negative ions, positive ions, and electrons is described. The diffusion properties of this nearly electron-free plasma are discussed. The stabilization of toroidal currents and confinement of toroidal, inductively heated plasmas by surface magnetic fields is discussed. This concept made possible the heating of a high Beta by a large toroidal current which did not affect the overall plasma stability. An experimental device is presented which sustained a toroidal plasma current in excess of 3 kA by using a surface magnetic layer of 500 G. Dissert. Abstr.

N78-19938*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOWER HYBRID EMISSION DIAGNOSTICS ON THE NASA LEWIS BUMPY TORUS
R. Mallavarpu 1977 14 p refs Presented at 19th Ann. Meeting of the Plasma Phys. Div. of the Am. Physical Soc., Atlanta, Ga., 7-11 Jul 1977
(NASA-TM-73858; E-9447) Avail: NTIS HC A02/MF A01 CSCL 20I

The feasibility of using RF emission near the lower hybrid frequency of the NASA Lewis Bumpy Torus plasma for diagnostic purposes is examined. The emission is detected using a spectrum analyzer and a 50 omega miniature coaxial antenna that is sensitive to the polarization of the incoming signal. The frequency shift of the lower hybrid emission peak is monitored as a function of the background pressure, electrode voltage, electrode ring configuration and the strength of the toroidal dc magnetic field. Simultaneous measurements of the average plasma density are made with a polarization diplexing microwave interferometer. Data derived from the experiment are discussed with reference to the following: (1) the strength of the dc magnetic field in the emitting region; (2) comparison of the lower hybrid plasma density with the average plasma density; and (3) validity of the cold plasma lower hybrid resonance formula in the high density operating regime of the bumpy torus plasma. Author

N78-19939# Hughes Research Labs., Malibu, Calif.
ION PLASMA ELECTRON GUN RESEARCH Final Report, 1 Jun. - 15 Nov. 1977
William M. Clark, Jr. and A. J. Palmer 9 Dec. 1977 38 p refs
(Contract N00014-77-C-0484; ARPA Order 1807)
(AD-A048621) Avail: NTIS HC A03/MF A01 CSCL 09/1

Experiments have been run and a comprehensive theoretical model developed which have enabled a more complete characterization of the ion plasma electron gun. The experiments provided important high current data on the operation of the gun and of the thin-wire discharges. The theoretical model included consideration of fifteen different reactions between helium atoms and ions and electrons and calculated the particle fluxes and the electric potential as a function of position in the high-voltage region. These calculated quantities described accurately the behavior of the gun at a beam voltage of 110 kV and enable a projection of operation of the e-gun at high voltages, such as 400 keV, with a beam current of 10 A/sq cm where the gun will be useful to pump excimer lasers. A qualitative understanding was obtained of the transient behavior of both the e-gun and

of the scaling properties of the thin-wire discharges.
Author (GRA)

N78-19940# Naval Research Lab., Washington, D. C. Laser Plasma Branch.
HIGH-ENERGY IONS IN LASER-PLASMA INTERACTIONS Interim Report
R. Decoste and B. H. Ripin Oct. 1977 13 p refs
(AD-A049061; AD-E000051; NRL-MR-3577) Avail: NTIS HC A02/MF A01 CSCL 20/8

A two-ion fluid, 1-D model is proposed to explain some features of the high energy ion distributions recently measured in laser-plasma interaction. The model describes the ambipolar expansion of hot electrons and two relatively cold ion species from a pressure gradient. The model accounts for the energy and relative behavior of high-energy ion species measured experimentally. Author (GRA)

N78-19941# Naval Research Lab., Washington, D. C. Plasma Dynamics Branch.
RUNAWAY ELECTRONS IN COLLECTIVE ELECTRIC FIELDS Interim Report
Bertram H. Hui (Science Applications, Inc., McLean, Va.) and Niels K. Winsor Sep. 1977 19 p refs
(AD-A049118; AD-E000047; NRL-MR-3614) Avail: NTIS HC A02/MF A01 CSCL 20/9

The interactions of runaway electrons with the anomalous-Doppler shifted mode and a bump-on-tail mode are studied numerically using the Fokker-Planck equation with a self-consistent quasilinear diffusion operator. The resulting frequency spectrum and the synchrotron radiation power agree with the experimental observations. Furthermore it is shown that there is a velocity threshold, below which electrons are not pitch-angle scattered by the self-consistent electric fields. The observed long-time behavior of synchrotron radiation data implies that this velocity threshold must shift to higher velocity as an experiment progresses. GRA

N78-19942# Oak Ridge National Lab., Tenn.
SUPERCONDUCTORS FOR TOKAMAK POLOIDAL FIELD COILS
R. E. Schwall, S. S. Shen, L. Dresner, J. W. Lue, J. R. Miller, and H. T. Yeh 1977 10 p refs Presented at the Cryogenic Eng. Conf., Boulder, Colo., 2 Aug. 1977
(Contract W-7405-eng-26)
(CONF-770801-17) Avail: NTIS HC A02/MF A01

The a.c. losses and stability of a number of model conductors for Tokamak poloidal field coils were evaluated. The conductors employ mixed matrix NbTi superconductor cabled with copper stabilizer and were tested with insulated strands, bare strands and solder filled. Data are presented for total loss per cycle as a function of maximum field and of field sweep rate. These losses are separated into filament hysteresis loss, filament coupling loss, stabilizing strand eddy loss and interstrand coupling loss. The data are compared with the predictions of a new theory which models the conductor as a LR circuit closely coupled to the magnet. Data are also presented for the velocity of propagation of recovery of a normal zone, the full recovery current and the minimum propagating current. The dependence of stability on the degree of coupling between the strands and on the amount of helium present in the cable is also discussed. ERA

N78-19943# Cornell Univ., Ithaca, N. Y.
LOWER HYBRID WAVE PROPAGATION IN INHOMOGENEOUS PLASMAS
E. Ott and C. S. Liu May 1976 9 p refs
(Contract EY-76-S-05-3405)
(LPS-224) Avail: NTIS HC A02/MF A01

Lower hybrid waves produced either by instabilities or by parametric decay of a pump wave had appreciable components of their wave vectors in the direction B/sub approx O/x Nabla N. The consequences of this were examined for propagation in inhomogeneous plasmas. ERA

N78-19944# Princeton Univ., N. J. Plasma Physics Lab.
TOROIDAL PLASMA TIME EVOLUTION. PART 2: OHMIC HEATING DURING START-UP
M. Stoenescu Aug. 1977 57 p
(Contract EY-76-S-02-2735)
(PPPL-1361-Pt-2) Avail: NTIS HC A04/MF A01

The inductive coupling between plasma and external coils and between various plasma subsections was taken into account. The plasma was considered in quasistatic equilibrium in the magnetic field generated by external coils. More correct transport treatment than in Part I of the present report and consideration of the neutral particles led to realistic time evolution of the radial skin current and temperature profiles when compared with experiments. ERA

N78-19945# General Atomic Co., San Diego, Calif.
HIGH CURRENT POWER LEADS FOR TOKAMAK FUSION REACTOR SUPERCONDUCTING MAGNETS
R. K. Thomas (Sandia Labs., Albuquerque, N. Mex.), J. R. Purcell, and R. W. Boom (Wisc. Univ., Madison) Jul. 1977 18 p refs Presented at Cryogenic Eng. Conf., Boulder, Colo., 2-5 Aug. 1977 Submitted for publication
(Contract EY-76-C-03-0167-038)
(GA-A-14503; Conf-770801-14) Avail: NTIS HC A02/MF A01

A power lead system consisting of a superconducting section and a normal section is presented. By gas cooling both sections and holding the junction at 15 K with a separate refrigeration loop, it is shown that less refrigeration power is needed, as compared to a normal metal gas cooled lead. For optimum helium mass flow rates, the refrigeration power at room temperature for a composite lead can be about 20% less than for a normal metal lead. ERA

N78-19946# Sandia Labs., Albuquerque, N. Mex.
DATA ACQUISITION AND PROCESSING ON ELECTRON BEAM FUSION ACCELERATORS
W. B. Boyer 1977 8 p Presented at Nucl. Sci. Symp., San Francisco., 19 Oct. 1977
(Contract EY-76-C-04-0789)
(SAND-77-0750C; Conf-771023-1) Avail: NTIS HC A02/MF A01

The hardware and software components of the custom data acquisition facility developed for the Sandia electron beam fusion research program is described. The facility contains a minicomputer system, transient digitizers, conventional oscilloscopes, and an image digitizer. Commercial equipment is utilized as much as possible. Careful cable shielding techniques are used to overcome the severe noise environments. The powerful capabilities of the multi-task operating system allow two simultaneous users. Special applications programs developed for data acquisition and reduction are described. A duplicate of this system will be built to support the next generation accelerator EBFA (Electron Beam Fusion Accelerator). ERA

N78-19947# California Univ., Livermore. Lawrence Livermore Lab.
FUSION BY GRAND CATASTROPHE
H. L. Sahlin Jul. 1977 12 p Presented at EPRI Review Meeting on Advanced Fuel Fusion, Chicago, 27 Jun. 1977
(Contract W-7405-eng-48)
(UCRL-79758; Conf-770644-3) Avail: NTIS HC A02/MF A01

The plasma focus, an accidentally discovered natural phenomenon, provides a pulsed power source of 10 to the 12th power-10 to the 13th power watts in a variety of forms: electron bursts, ion bursts, and the stagnation and direct field heating of the snowplow. High density fusion work with a plasma focus with maximum bank energy of 500 kJ at 40 kV is described. The plasma focus is used as a pulsed power source to explore various fusion microexplosion concepts. The first exotic fuel experiments carried out by operating the focus on D2+He3 at 120 kJ and 27 kV are discussed. ERA

N78-19948# Princeton Univ., N. J. Plasma Physics Lab.
TURBULENT TEMPERATURE FLUCTUATIONS IN THE PLT TOKAMAK PLASMA
V. Arunasalam, R. Cano, J. C. Hosea, and E. Mazzucato Jul. 1977 15 p refs
(Contract EY-76-C-03-3073)
(PPPL-1363) Avail: NTIS HC A02/MF A01

The first experimental evidence for the existence of turbulent

temperature fluctutations in plasmas is presented. The measurements of temperature turbulence were accomplished by a spectral analysis black-body electron cyclotron emission. The fractional fluctuation in the mean electron energy F is about 10% for typical PLT discharges. The frequency spectrum of the temperature turbulence extends well beyond the electron diamagnetic drift frequency F and does not show any resemblance to the simultaneously existing turbulent drift wave density fluctuations. ERA

N78-19949# California Univ., Livermore. Lawrence Livermore Lab.
STREAMING-PLASMA MEASUREMENTS IN THE BASEBALL II-T MIRROR EXPERIMENT
C. C. Damm, J. H. Foote, A. H. Futch, R. K. Goodman, R. S. Hornady, J. E. Osher, and G. D. Porter 9 May 1977 25 p refs
(Contract W-7405-eng-48)
(UCRL-52279) Avail: NTIS HC A02/MF A01

The warm plasma from a deuterium-loaded titanium washer gun, streaming along magnetic-field lines through the steady-state magnetic well of Baseball II, has been examined for its suitability in this experimental situation as a target plasma for hot-iron buildup experiments and for microinstability control. The gun was positioned near the magnetic axis outside the mirror region. Measurements were made with gridded, end-loss detectors placed outside the opposite mirror, a microwave interferometer, a beam-attenuation detector, and other diagnostics. ERA

N78-19950# Illinois Univ., Urbana.
POTENTIAL WELL FORMATION IN ELECTROSTATIC CONFINEMENT DEVICES
B. E. Cherrington and J. T. Verdeyen 1976 23 p refs
(Contract EY-76-S-02-2323)
(COO-2323-6) Avail: NTIS HC A02/MF A01

Electron injection experiments on the large spherical inertial electrostatic plasma confinement devices were extended to much higher voltages and currents (up to 10 kV and up to 25 A). Electron beam diagnostics verified the production of a deep negative electrostatic well under high vacuum conditions and a multiple potential well when low pressure deuterium is added. A movable electrostatic probe was to show that the ions produced within the chamber can be focussed towards the center of the device with very low divergence. Theoretical work was done to clarify the electron and ion parameters for which a triple well structure (trapped ions or trapped electrons) can be expected to be produced. A small hydrogen negative ion source was constructed and is under study as a possible source for ion diagnostics. ERA

N78-19951# Illinois Univ., Urbana. Fusion Studies Lab.
D-DT PELLET LASER-FUSION FEEDBACK CONCEPTS
G. H. Miley, C. K. Choi, and S. Sutherland 1977 8 p refs
(Contract EY-76-S-02-2007)
(COO-2007-88) Avail: NTIS HC A02/MF A01

A laser-fusion reactor employing deuterium-rich pellets to produce 2.45 and 14 MeV neutrons pumping of a Direct-Nuclear-Pumped Laser (DNPL) as a feedback coupling mode is considered. The DNPL utilizes MeV ions produced by neutron-driven nuclear reactions to pump a laser and a deuterium-rich pellet burn by the laser produces neutrons. Hence, the neutrons from one pellet burn drive the laser in order to ignite next pellet by which laser-fusion coupling scheme with DNPL is achieved. ERA

N78-19952# General Atomic Co., San Diego, Calif.
FINITE ELEMENT METHODS FOR ANALYSIS OF TOROIDAL FIELD COILS IN FUSION DEVICES
C. M. Charman Jul. 1977 19 p refs Presented at the Intern. Conf. on Structural Mech. in Reactor Technol., San Francisco, 15-19 Aug. 1977
(Contract EY-76-C-03-0167-038)
(GA-A-14389; Conf-770807-20) Avail: NTIS HC A02/MF A01

The eight node isoparametric quadrilateral element having quadratic interpolation was used in an analysis of the Doublet 3 B-coil. The shape functions interpolate vector or scalar quantities within the element in terms of the function values at the nodal points. Calculations were made for the electric potential and current density throughout the b coil. The mathematics for calculating the stresses and deformation throughout the coil were given. ERA

N78-19953# Maryland Univ., College Park.
INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES Final Report
H. Lashinsky 1977 46 p refs
(Contract EY-76-S-05-3405)
(ORO-31) Avail: NTIS HC A03/MF A01

Universal plasma instabilities were investigated under a variety of conditions and a wide range of experimental parameters to scale the results appropriately to make comparisons with plasma of thermonuclear interest. Of particular importance are the roles played by collisions and resonance particles (Landau damping and excitation) and the various stages in the development of the instabilities i.e., the linear onset of the instability, the quasilinear stage, and the transition to turbulence. General nonlinear effects such as mode locking and mode competition, and the relation of these phenomena to plasma turbulence, are also considered. The ultimate aim was to measure certain plasmas transport coefficients in the plasma under stable and turbulent conditions with the particular view of evaluating the effect of the universal plasma instabilities of plasma confinement in a magnetic field. ERA

N78-19954# Texas Univ., Austin. Plasma Waves Lab.
ION RESONANCE HEATING STUDIES Final Report
D. G. Swanson 1976 5 p refs
(Contract EY-76-S-05-3871)
(ORO-3871-10) Avail: NTIS HC A02/MF A01

The RF heating observed in a plasma at harmonics of the ion cyclotron frequency when no fast wave was expected was investigated. It was suggested that an electrostatic ion cyclotron wave or a modified Ion Bernstein wave was responsible for the observed heating and an experimental program was developed to clarify the physics and determine its potential for fusion. ERA

N78-19955# Princeton Univ., N. J. Plasma Physics Lab.
TOROIDAL PLASMA TIME EVOLUTION. PART 1: MULTIPLE-NODE MODEL Progress Report
M. Stoensecu Nov. 1976 63 p
(Contract EY-76-S-02-2735)
(PPPL-1294) Avail: NTIS HC A04/MF A01

The inductive coupling between plasma and external coils and between various subsections was taken into account. The plasma was considered in quasistatic equilibrium in the magnetic field generated by external coils which control the compression. Numerical results were provided for the Reference Design. ERA

N78-19956# Princeton Univ., N. J. Plasma Physics Lab.
MOMENT EQUATION APPROACH TO NEOCLASSICAL TRANSPORT THEORY
S. P. Hirshman Sep. 1977 25 p refs
(Contract EY-76-C-02-3073)
(PPPL-1378) Avail: NTIS HC A02/MF A01

The neoclassical cross field fluxes for a toroidally confined, axisymmetric plasma were calculated in terms of the thermodynamic forces from the fluid continuity and momentum balance equations. This macroscopic formulation of neoclassical transport theory unifies the numerous complex expressions for the transport coefficients, and elucidates their physical basis. In the large aspect ratio limit, the continuous transition in the scaling of the diffusion coefficient throughout various collisionality regimes was shown to depend on the ratio of parallel viscosity coeffecients of the plasma species. ERA

N78-19957# California Univ., Livermore. Lawrence Livermore Lab.
LARGE-SCALE CRYOPUMPING FOR CONTROLLED FUSION
Lee C. Pittenger 25 Jul. 1977 20 p refs Presented at Cryogenic Eng. Conf., Boulder, Colo., 2-5 Aug. 1977
(Contract W-7405-eng-48)
(UCRL-79381; Conf-770801-16) Avail: NTIS HC A02/MF A01

Vacuum pumping by freezing out or otherwise immobilizing the pumped gas is an old concept. In plasma physics experiments

for controlled fusion research, cryopumping is used to provide clean, ultrahigh vacua. Cryopumping systems developed for neutral beam injection systems on several fusion experiments (HVTS, TFTR) and for the overall pumping of a large, high-throughput mirror containment experiment (MFTF) are described. In operation, these large cryopumps will require periodic defrosting, some schemes for which are discussed, long with other operational considerations. Likely paths for necessary further development for power-producing reactors are also discussed. ERA

N78-19958# Westinghouse Electric Corp., Pittsburgh, Pa. Large Rotating Apparatus Div.

CONCEPTUAL STUDIES OF TOROIDAL FIELD MAGNETS FOR THE TOKAMAK EXPERIMENTAL POWER REACTOR Final Report

B. R. Buncher, J. W. H. Chi, and R. Fernandez 26 Oct. 1976 656 p refs

(Contract EY-76-C-05-5153)

(ORO-5153-1) Avail: NTIS HC A99/MF A01

Two concepts for the superconducting toroidal field system for a Tokamak experimental power reactor are described for peak operating fields at the windings of 8 tesla, and 12 tesla, respectively. The design and manufacturing considerations are treated in sufficient detail that cost and schedule estimates could be developed. Major uncertainties in the design are identified and their potential impact discussed, along with recommendations for the necessary research and development programs to minimize these uncertainties. The minimum dimensions of a sub-size test coil for experimental qualification of the full size design are developed and a test program is recommended. ERA

N78-19959# General Electric Co., Schenectady, N. Y. Energy Systems Programs Dept.

CONCEPTUAL STUDIES OF TOROIDAL FIELD MAGNETS FOR THE TOKAMAK (FUSION) EXPERIMENTAL POWER REACTOR Final Report

1 Nov. 1976 212 p refs Prepared in cooperation with Intermagnetics General Corp., Guilderland, N. Y.

(Contract EY-76-C-05-5154)

(ORO-5154-1) Avail: NTIS HC A10/MF A01

Two conceptual coil designs were developed. One design approach to produce a specified 8 Tesla maximum field uses a novel NbTi superconductor design cooled by pool boiling liquid helium. For a highest practicable field design, a unique NbSn3 conductor was used with forced flow, single phase liquid helium cooling to achieve a 12 Tesla peak field. Fabrication requirements were also developed for these approximately 7 meter horizontal bore by 11 meter vertical bore coils. Cryostat design approaches were analyzed and a hybrid cryostat approach selected. Structural analyses were performed for approaches to support in plane and out of plane loads and a structural approach selected. Cost estimates and schedules were prepared for each of the design approaches, major uncertainties and recommendations for research and development identified, and test coil size for demonstration recommended. ERA

N78-19960# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.

EUV IMPURITY STUDY OF THE ALCATOR TOKAMAK

J. L. Terry, K. I. Chen, H. W. Moos, and E. S. Marmar, (MIT, Cambridge) Jun. 1977 63 p refs

(Contract EY-76-S-02-2711)

(COO-2711-3) Avail: NTIS HC A04/MF A01

The intensity of resonance line radiation from oxygen, nitrogen, carbon and molybdenum impurities was measured in the high field, high density discharges of the Alcator Tokamak, using a 0.4 m normal incidence monochromator (300 to 1300 A) with its line of sight fixed along a major radius. Both a simple model and a computer code which included Pfirsch-Schluter impurity diffusion were used to estimate oxygen influxes at the plasma edge in the low and high density emission plateaus. The resulting values of Z/sub eff/, including the contributions due to both the light impurities and molybdenum, were close to one. The power lost through the impurity line radiation accounted for approximately equal to 7 percent of the total ohmic input power at high densities. ERA

N78-19961# Oak Ridge National Lab., Tenn.

PLASMA SIMULATION AND MODELING FOR ELMO BUMPY TORUS REACTOR

N. A. Uckan and C. L. Hedrick Oct. 1977 38 p refs

(Contract W-7405-eng-26)

(ORNL-TM-6019) Avail: NTIS HC A03/MF A01

A time-dependent deuterium-tritium point model was formulated to assess the energy balance in an ELMO Bumpy Torus Reactor (EBTR) plasma. The effects of the different scaling assumptions on EBTR performance and operating point were analyzed. Although in the present EBT device (EBT-I) plasma transport seems to be governed largely by neoclassical processes, hypothesized anomalous transport losses are included in the plasma simulation model in addition to neoclassical and for classical transport in order to test the sensitivity of EBTR parameters. For the particular case studied, it is shown that the reference EBTR can accommodate anomalous losses one to two orders of magnitude greater than the present neoclassical losses at the operating point (steady state). Results are discussed. ERA

N78-19962# California Univ., Livermore. Lawrence Livermore Lab.

DIAGNOSTICS SYSTEMS DEVELOPMENTS AND APPLICATIONS FOR LASER FUSION EXPERIMENTS

L. W. Coleman 8 Sep. 1977 18 p refs Presented at 2d Conf. on Hot Plasma Diagnostics, Kharkov, USSR, 22 Sep. 1977

(Contract W-7405-eng-48)

(UCRL-80058(rev.1); Conf-770954-1) Avail: NTIS HC A02/MF A01

A variety of systems required for adequate diagnostics of laser fusion experiments are discussed. Picosecond scale temporal measurements are typically made with ultrafast streak cameras. Visible and X-ray sensitive streak cameras with resolution of 6 psec and 15 psec, respectively, and dynamic recording range in excess of 1,000 are in regular use on experiments at Livermore. The characteristics of these cameras and their applications to target experiment diagnostics are described. The development and testing of a prototype ultrafast framing system is discussed. Because of the need for real time data acquisition, analysis, and control systems, techniques for providing directly computer interfaced image data from streak and framing cameras and optical imaging systems are being developed. The status of these developments and the characteristics of the computer interfaced data and control systems on Argus and Shiva are summarized. ERA

N78-19963# California Univ., Livermore. Lawrence Livermore Lab.

EFFECTS OF BEAT-WAVE ELECTRON TRAPPING ON STIMULATED RAMAN AND THOMSON SCATTERING

B. I. Cohen and A. N. Kaufman 13 Sep. 1977 38 p refs

(Contract W-7405-eng-48)

(UCID-17582) Avail: NTIS HC A03/MF A01

The influence of electron trapping on a large-amplitude plasma oscillation driven by the nonlinear interaction of two electromagnetic waves (stimulated Raman scattering) is studied analytically and by means of numerical simulation. When the plasma oscillation is resonantly excited to sufficiently large amplitude and electron trapping occurs, there ensues considerable modification of the electron velocity distribution function. The stimulated scattering ceases to be a resonant three-wave process, but continues as induced scattering by resonant electrons (stimulated Thomson scattering). ERA

N78-19964# California Univ., Livermore. Lawrence Livermore Lab.

PLASMA PRODUCTION AND FLOW IN ION BEAMS

E. B. Hooper, Jr. and P. A. Willmann 22 Aug. 1977 29 p refs

(Contract W-7405-eng-48)

(UCID-17559) Avail: NTIS HC A03/MF A01

Space charge neutralization of ion beams results from plasma generated by the beam. The two dimensional flow of plasma to walls surrounding a beam is analyzed to provide spatial distributions. Negative ion beams receive particular attention; the results are applied to electron control in beams subject to post-acceleration. ERA

N78-19965# Princeton Univ., N. J. Plasma Physics Lab.
LANDAU DAMPING OF LOW AND HIGH POWER SLOW ELECTROSTATIC WAVES
F. J. Paoloni, R. W. Motley, W. M. Hooke, and S. Bernabei Sep. 1977 15 p
(Contract EY-76-C-02-3073)
(PPPL-1372) Avail: NTIS HC A02/MF A01

Waves were excited in a warm plasma at frequencies above the lower hybrid frequency and their damping characteristics were measured under a variety of conditions. Strong wave absorption was measured if omega/k/sub double prime/ less than or equal to 3 v/sub e/, in agreement with the predictions of linear Landau damping. At a certain critical power level, consistent with the power required to flatten the velocity distribution, the absorption disappears. Above this level evidence was obtained for the appearance of an enchanced electron tail between 80-250 eV, in and above the energy range where Landau damping should occur. ERA

N78-19966# Los Alamos Scientific Lab., N. Mex.
PHOTO IONIZATION CROSS SECTIONS AND RADIATIVE RECOMBINATION RATE COEFFICIENTS FOR POSITIVE IONS OF CARBON AND GOLD
W. D. Barfield Sep. 1977 24 p refs
(Contract W-7405-eng-36)
(LA-6615) Avail: NTIS HC A02/MF A01

Partial photoionization cross sections based on a nonhydrogenic single-electron model that utilizes Dirac-Slater wave functions and all necessary multipoles were computed for C III-VI and Au + 8, + 16, + 24, and + 36 for n = 1 -6 and 10, 0 less than or equal to 1 less than n. By use of detailed balance, radiative recombination rate coefficients are obtained for seven temperatures in the range 10 eV to 3 keV from the photoionization cross sections. The cross sections are compared with those obtained by others using semiclassical (Kramers) and hydrogenic models. In most cases, the recombination rate coefficients (summed over subshells) are larger than those computed using hydrogenic photoionization cross sections, by as much as a factor 30 (Au + 8, n = 5, kT = 43 keV). Analytical fits are given for the rate coefficients summed over 1 and n. The results are applicable to ionization balance and ion transport calculations for fusion reactors and the solar corona. ERA

N78-19967# Oak Ridge National Lab., Tenn.
MAGNETIC FUSION ENERGY MATERIALS TECHNOLOGY PROGRAM Annual Progress Report, 30 Jun. 1977
J. L. Scott Sep. 1977 127 p
(Contract W-7405-eng-26)
(ORNL-5323) Avail: NTIS HC A07/MF A01

The objectives of the magnetic fusion energy (MFE) materials technology program are to solve the materials problems of the fusion energy division of ORNL and to meet needs of the national MFE program, directed by the ERDA Division of Magnetic Fusion Energy (DMFE). The principal areas of work include radiation effects, compatibility studies, materials studies related to the plasma-materials interaction, engineering, radiation behavior of superconducting magnet insulation, and mechanical properties of superconducting composites. ERA

N78-19968# Oak Ridge National Lab., Tenn.
PROPOSAL FOR A MAJOR MODIFICATION TO THE ISX TOKAMAK TO STUDY EQUILIBRIUM AND STABILITY OF EXTERNALLY HEATED HIGH BETA PLASMAS IN NONCIRCULAR GEOMETRY
D. W. Swain, T. E. Smith, D. J. Sigmar, and M. Murakami Sep. 1977 37 p
(Contract W-7405-eng-26)
(ORNL-TM-5985) Avail: NTIS HC A03/MF A01

The eventual use of Tokamaks as economical fusion power generators will require the confinement of plasmas with values of beta greater than or equal to 5%. The ISX Tokamak at Oak Ridge National Laboratory can be modified to study the equilibrium, stability, and transport of a plasma with beta in the 3-5% range. This can be achieved by adding up to 3 MW of neutral beam injection power on the machine and by replacing the vacuum chamber and poloidal field coils. The design, cost, and schedule for the modification are covered in this proposal, in addition to the reasons for performing these experiments.ERA

N78-19969# Magnetic Corp. of America, Waltham, Mass.
DESIGN STUDY OF TOROIDAL MAGNETS FOR TOKAMAK EXPERIMENTAL POWER REACTORS
Z. J. J. Stekly, ed. and E. J. Lucas, ed. Dec. 1976 412 p refs
(Contract EY-76-C-05-5152)
(ORO-5152-1) Avail: NTIS HC A18/MF A01

The results of a six-month study of superconducting toroidal field coils for a Tokamak experimental power reactor to be built in the late 1980s is reported. The designs are for 8 T and 12 T maximum magnetic field at the superconducting winding. At each field level two main concepts were generated; one in which each of the 16 coils comprising the system has an individual vacuum vessel and the other in which all the coils are contained in a single vacuum vessel. The coils have a D shape and have openings of 11.25 m x 7.5 m for the 8 T coils and 10.2 m x 6.8 m for the 12 T coils. All the designs utilize rectangular cabled conductor made from copper stabilized Niobium Titanium composite which operates at 4.2 K for the 8 T design and at 2.5 K for the 12 T design. Manufacturing procedures, processes and schedule estimates are also discussed. ERA

N78-19970# Princeton Univ., N. J. Plasma Physics Lab.
ELECTRON CYCLOTRON EMISSION FROM THE PLT TOKAMAK
J. C. Hosea, V. Arunasalam, and R. Cano Jul. 1977 14 p refs
(Contract EY-76-C-02-3073)
(PPPL-1362) Avail: NTIS HC A02/MF A01

Experimental measurements of electron cyclotron emission from the PLT Tokamak plasma revealed that black body emission occurs at the fundamental frequency. Such emission, was herein attributed to thermal excitation of electrostatic waves which then mode convert into electromagnetic waves. The local feature of the electrostatic wave generation permits spatially and time resolved measurements of electron temperature as for the second harmonic emission. ERA

N78-19971# Argonne National Lab., Ill.
FUNCTIONAL-INTEGRAL FORMULATIONS FOR PLASMA INSTABILITIES AND TURBULENCE: ANALOGIES WITH PHASE-TRANSITION PHENOMENA
R. C. Arnold Jun. 1977 15 p refs
(Contract W-31-109-eng-38)
(ANL-HEP-PR-77-34) Avail: NTIS HC A02/MF A01

A function-integral representation for generating functionals in plasma transport theory is written. Parallel treatments of Navier-Stokes turbulence and of critical dynamics, are compared to illustrate the application of common field theory techniques, such as the effective action. Quasi-classical methods for functional integrals are discussed. ERA

N78-19972# Princeton Univ., N. J. Plasma Physics Lab.
DYNAMICAL GRID METHOD FOR TIME DEPENDENT SIMULATIONS OF AXISYMMETRIC INSTABILITIES IN TOKAMAKS
S. C. Jardin, J. L. Johnson, J. M. Greene, and R. C. Grimm Jul. 1977 57 p refs
(Contract EY-76-C-02-3073)
(PPPL-1359) Avail: NTIS HC A04/MF A01

A natural nonorthogonal time dependent coordinate transformation based on the magnetic field lines was utilized for the numerical integration of the two dimensional axisymmetric time dependent ideal magnetohydrodynamic (MHD) equations in Tokamak geometry. The finite difference grid was treated as a dynamical variable, and its equations of motion were integrated simultaneously with those for the fluid and magnetic field. The method was applicable to Tokamak systems of arbitrary pressure and cross section. It was particularly useful for the nearly incompressible ideal MHD modes which were of interest in Tokamak stability studies. ERA

N78-19973# Cornell Univ., Ithaca, N. Y. Lab. of Plasma Studies.
THEORETICAL STUDIES ON PLASMA HEATING AND CONFINEMENT Progress Report, 16 Oct. 1976 - 15 Oct. 1977
1977 51 p refs

(Contract EY-76-S-02-3170)
(COO-3170-6) Avail: NTIS HC A04/MF A01

The high frequency flute like electrostatic normal models were found for a long thin field reversed ion ring immersed in a much denser, colder, uniform background plasma. Instabilities of the weak beam type were found at frequencies somewhat above the lower hybrid frequency. For a sufficiently high energy most of these modes were stabilized by electron cyclotron damping near the surface of field reversal. The growth rate of these modes was lower for higher beam energies, fatter rings, and greater degrees of field reversal. For reasonable parameters, the maximum growth rate can be as low as a fraction of one percent of the ion cyclotron frequency. These remaining modes may be stable if the background plasma is nonuniform or if the ring is not long and thin. ERA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

N78-19974 Princeton Univ., N. J.
THE ZnSe (110) SURFACE: ITS ATOMIC GEOMETRY AND ORDER-DEPENDENT OXYGEN SORPTION Ph.D. Thesis
Matthew Alexander Bonn 1977 93 p
Avail: Univ. Microfilms Order No. 77-28112

Because of the expense of dynamical Low Energy Electron Diffraction (LEED) computer calculations, it is desirable to compare measured LEED intensity profiles with kinematically computed LEED intensity profiles as a first step in defining a probable region of surface atomic position parameter space. Once an approximate structure is achieved, further refinements can be made by dynamical analyses. The kinematical theory of LEED is reviewed. A substantial data base of LEED intensity measurements from ZnSe(110) is reported. These intensity profiles are compared with kinematically computed curves based on several different surface atomic geometries. The room temperature oxidation kinetics of ordered and disordered ZnSe(110) surface are reported. Dissert. Abstr.

N78-19975 Cornell Univ., Ithaca, N. Y.
MORPHOLOGY AND PURITY OF EPITAXIAL INDIUM PHOSPHIDE GROWN BY LIQUID PHASE EPITAXY Ph.D. Thesis
Sunil Bhaskar Phatak 1977 127 p refs
Avail: Univ. Microfilms Order No. 77-28406

Various parameters involved in epitaxial growth of InP are examined. The dependence of epilayer morphology and impurity content on substrate characteristics, growth temperature, heating schedules and LPE reactor performance is discussed on the basis of experimental investigation. One of the main sources of problems is oxygen and water vapor contamination of the growth ambient. An in-situ pure Indium etching method is described which effectively deals with this problem by removing the surface oxides, as well as the pits from phosphorus loss, in order to get good morphology. In the post nucleation growth phase, the dependence of morphology on substrate orientation was examined. For getting high purity epilayers, the effect of baking time and different growth temperatures was investigated. Further, to reduce carbon contamination, a quartz boat is described. Dissert. Abstr.

N78-19976 Cornell Univ., Ithaca, N. Y.
ELECTRIC CURRENT CONTROLLED LIQUID PHASE EPITAXY OF GaAs ON N(+) AND SEMI-INSULATING SUBSTRATES: GROWTH PARAMETERS AND DOPING MODULATION Ph.D. Thesis
David Joseph Lawrence 1977 211 p
Avail: Univ. Microfilms Order No. 77-29373

Growth was induced and sustained by current flow across the substrate-melt interface. The furnace temperature was held constant during growth so that direct electrical control of the growth process was achieved. The dependence of the growth rate on both the electric current density across the substrate-melt interface and the ambient furnace temperature was determined. In all cases, the measured growth rate greatly exceeds the values predicted by assuming that diffusion limited growth with no convection occurs in the presence of the temperature gradient established by Peltier cooling at the substrate-melt interface. Quantitative information about electric current controlled doping modulation was obtained from doping profile measurements performed on epilayers grown from unintentionally doped melts, tin doped melts, and tellurium doped melts. Dissert. Abstr.

N78-19977 California Univ., Berkeley.
SURFACE CRYSTALLOGRAPHY OF CLEAN PLATINUM SINGLE CRYSTALS AND ADSORBED HYDROCARBON OVERLAYERS STUDIES BY LOW ENERGY ELECTRON DIFFRACTION Ph.D. Thesis
Peter Curran Stair 1977 225 p
Avail: Univ. Microfilms Order No. 7731552

The intensities of the low-energy electron diffraction (LEED) beams backscattered from the clean platinum (111) and clean, reconstructed platinum (100) surfaces are measured by a photographic technique. The LEED intensities are also measured for ordered hydrocarbon overlayers of acetylene, ethylene, methylacetylene, propylene and benzene adsorbed on the Pt (111) surface. The intensities are presented in the form of normalized diffraction beam intensity versus incident electron energy (I-V curves). The fluorescent screen is photographed in a conventional, 4-grid LEED system using a 35 mm camera. The film is machine developed and scanned using a computer controlled microdensitometer. The output from the densitometer is computer analyzed to obtain well calibrated diffraction beam intensities which are compared to a dynamical LEED calculation in order to obtain the structure of the surface region. Dissert. Abstr.

N78-19978 California Univ., Berkeley.
CALCULATIONS OF PARITY VIOLATION IN FORBIDDEN M1 TRANSITIONS OF THALLIUM AND CESIUM Ph.D. Thesis
David Vincent Neuffer 1977 89 p
Avail: Univ. Microfilms Order No. 77-31478

Calculations are presented of the E1 amplitude expected in forbidden M1 transitions of Tl and Cs if parity is violated in the neutral weak e-N interaction, as proposed in a number of gauge models, including that of Weinberg and Salam. Wave functions are used to calculate allowed E1 transition rates, hfs splittings, and Stark E1 transition amplitudes. Dissert. Abstr.

N78-19979 Cornell Univ., Ithaca, N. Y.
LOW TEMPERATURE ELECTRON AND PHONON SCATTERING RATES IN POTASSIUM AND SPIN RELAXATION OF HELIUM THREE AT SURFACES Ph.D. Thesis
Robert Charles Albers 1977 269 p
Avail: Univ. Microfilms Order No. 78-00116

Non-equilibrium behavior and scattering rates have been investigated for two different systems-metallic potassium and the 3He-solid interface. In the first system, metallic potassium, phonon decay rates due to electron-phonon and phonon-phonon scattering are calculated and compared for small wave numbers at low temperature (1-20 K). In the second system, a general microscopic theory is developed to understand some anomalous properties observed in several, recent, nuclear-magnetic-resonance experiments at low temperatures (35 mK - 4 K) for 3He which is absorbed, or in contact with a variety of substrates containing electronic paramagnetic spins. A detailed comparison is made between the Kapitza conductance and the spin-lattice relaxation rate. Dissert. Abstr.

N78-19980 Northwestern Univ., Evanston, Ill.
THERMALLY STIMULATED DISCHARGE CURRENT STUDIES ON POLYCARBONATE, POLYSULFONE, AND THEIR BLENDS Ph.D. Thesis
Yoshio Aoki 1977 164 p
Avail: Univ. Microfilms Order No. 77-32274

Polycarbonate polysulfone and their blends are of commercial prominence due to their relatively high glass transition and their superior ductility and impact strength. Dielectric relaxation measurements at very low frequency were carried out. Chain backbone motion in polycarbonate was investigated by the Thermally Stimulated Discharge Current Method (TSC). The (TSC) studies on polycarbonate/polysulfone blends revealed a definite

compositional dependence. The results suggested that the polarization in the blend at the phase inversion was mainly due to molecular motion associated with dipole moments. Addition of small quantities of polysulfone to polycarbonate results in a large increase in the activation energy. Dissert. Abstr.

N78-19981 Connecticut Univ., Storrs.
PHONON SCATTERING PROCESSES AND THERMAL CONDUCTION IN COPPER ALLOYS AT VERY LOW TEMPERATURES Ph.D. Thesis
Alan Charles Bouley 1977 364 p
Avail: Univ. Microfilms Order No. 77-31061

The low temperature lattice thermal conductivity of alloys of copper with nickel, aluminum, and germanium as solute species was studied. The lattice thermal conductivity was extracted from the measured total thermal conductivity, for most samples in the temperature range from approximately 0.4 K up to from 45 K to 70 K. Samples of these alloys were measured in states of heavy deformation, differing moderate and high temperature anneals and, in the case of the Cu + 9.99 at. percent Al alloy, after irradiation by fast neutrons. These determinations of the lattice thermal conductivity provided a means by which the various phonon scattering mechanisms present in the samples could be investigated. The electrical resistivity of all samples was also determined at several liquid helium temperatures below 4.2 K; all samples were already in the realm of the residual resistivity by 4 K. Dissert. Abstr.

N78-19982 California Univ., Berkeley.
TRICRITICAL BEHAVIOR IN TWO DIMENSIONS Ph.D. Thesis
Alan Lance Lewis 1977 72 p
Avail: Univ. Microfilms Order No. 77-31437

The onset of two dimensional tricritical behavior in N x infinity strips of spins in an Ising-like model is investigated. This is done through numerical computation of the largest eigenvalue of the single spin advance transfer matrix. Primary attention is paid to the specific heat at constant non-ordering field. The usual phase diagram, in zero ordering field, locates the tricritical point at the intersection of a first order line and a lambda line; it is found here that a curve of large field, bounded and rounded specific heat peaks also seems to intersect this point. This curve, when it exists, may be helpful in experimentally locating tricritical points in any dimension. Evidence is also presented, in zero non-ordering field, for the validity of the Onsager specific heat temperature shift, N to the minus 2 power in N, in the model. Dissert. Abstr.

N78-19983 California Univ., Berkeley.
SURFACE ACOUSTIC WAVE DIFFERENTIATOR, AND SLOW-WAVE MIS AND SCHOTTKY BARRIER MICROSTRIPS Ph.D. Thesis
Tzu-Hwa Hsu 1977 158 p
Avail: Univ. Microfilms Order No. 77-31402

The operation of a surface wave differentiator for the extraction of data samples stored in the form of surface acoustic waves is discussed and a programmable differentiator is described. Because of the limitations of surface acoustic wave delay lines methods were developed for reducing the losses associated with a slow wave propagating along a metal-insulator-semiconductor transmission line, observations of some interesting properties of a not-so-common II-VI semiconductor, PbTe, resulted in the realization of a Pb-PbTe Schottky barrier microstrip allowing the propagation of slow waves with a phase velocity many hundred times smaller than the velocity of light. Theoretical calculations are also made to point out the potential applications of the device. Dissert. Abstr.

N78-19984 Cornell Univ., Ithaca, N. Y.
INTERBAND SCATTERING EFFECT ON THE SECONDARY IONIZATION COEFFICIENTS OF GaAs AND THE RELATED TECHNOLOGICAL DEVELOPMENT Ph.D. Thesis
Hsiang-Yi David Law 1977 126 p
Avail: Univ. Microfilms Order No. 7800100

The ionization rates of holes and electrons in GaAs were measured by the photomultiplication method. Pure electrons were injected by illuminating the opaque platinum on the platinum Schottky barrier diodes and pure holes were injected from tye substrate side with strongly absorbed light. The dependence of the electron ionization rate on doping is explained by the requirement that electrons must make an interband transition before reaching ionization threshold energy. This interband transition time estimated by this experiment is in the order of 10 - thirteen second. The breakdown voltages versus doping concentration were calculated and matched closely with the experimentally observed ones. The GaAs diode fabrication techniques such as metal deposition to form Schottky barriers and ohmic contacts, anod c oxidation, anodic etching, ion implantation and diffusion are discussed. Dissert. Abstr.

N78-19985 Ohio State Univ., Columbus.
THERMOELECTRIC FLUX EFFECT IN SUPERCONDUCTING INDIUM Ph.D. Thesis
Dale Jay VanHarlingen 1977 96 p
Avail: Univ. Microfilms Order No. 7731999

A mechanism for studying quasi-particle relaxation and scattering processes in non-equilibrium superconductors by transport measurements is described. An unquantized magnetic flux is generated in a bimetallic superconducting circuit when one junction is heated with respect to the other. The flux arises to maintain the long-range phase coherence around the ring in the presence of the superfluid current which flows in response to the thermally-driven quasiparticle current. The magnetic flux may be expressed in terms of the thermoelectric flux, which is a characteristic transport property of a superconductor. Measurements of the thermoelectric flux effect in samples consisting of indium and lead near the In transition temperature.
Dissert. Abstr.

N78-19986 Ohio State Univ., Columbus.
THE IDENTIFICATION OF SURFACE INTERACTIONS IN THIN MAGNETIC GARNET FILMS Ph.D. Thesis
Peng Yen 1977 89 p
Avail: Univ. Microfilms Order No. 77-32014

By using the angle dependence of the mode separations and intensity ratios of the surface modes as well as body modes based on the pinning parameter model under asymmetric boundary conditions, coefficients were determined for the free surface and the substrate of an annealed thin YIG film grown on a GdGaG substrate at different temperatures. Analyses of the data in terms of the angle dependence and temperature dependence of the surface anisotropy and the study of the photoinduced changes in the spin wave spectrum allow a realistic approach to the evaluation of various microscopic interactions that might give rise to these results. A microscopic model including single ion anisotropy, a temperature and frequency dependent molecular field coupling between the iron spins and the gadolinium spins at the film substrate interface is proposed. Dissert. Abstr.

N78-19987 California Univ., Berkeley.
SCATTERING CHARACTERISTICS AND CATALYTIC ACTIVITY OF SINGLE CRYSTAL SURFACES
Richard Isaac Masel 1977 367 p
Avail: Univ. Microfilms Order No. 77-31461

A rigorous theoretical formulation of elastic scattering of atoms and molecules from solid surfaces was developed, and is shown to be in quantitative agreement with experimental data and in quantitative agreement in the case of helium scattering from W (112) . The analogy between the motion of electrons in periodic solids and the motion of atoms on periodic surfaces was exploited to make quantitative predictions of surface diffusivities and to examine level shifts and splittings in selective adsorbtion. The diffraction of low energy (i.e., less than 1000 ev) electrons was formulated for application to a larger class of pseudo-potentials than the methods currently in use.
Dissert. Abstr.

N78-19988# Sperry Rand Research Center, Sudbury, Mass.
MAGNETIC LPE CRYSTALLINE FILMS FOR SMALL BUBBLE DIAMETER CYLINDRICAL-DOMAIN MEMORY APPLICATIONS
M. Kestigian, W. R. Bekebrede, and A. B. Smith Wright-Patterson AFB, Ohio AFAL Jul. 1977 34 p refs
(Contract F44620-76-C-0121)
(AD-A048462; SCRC-CR-77-1; AFAL-TR-77-33) Avail: NTIS HC A03/MF A01 CSCL 09/2

This was an interim technical report which covers the research performed during the first six months of the contract period. The report includes a description of the preparation, characterization and magnetic property evaluation of liquid-phase epitaxial (LPE) crystalline-garnet films for 2 micron bubble diameter memory devices. Over four-hundred and fifty different LPE preparations were made and thin films grown. Representative results of this research were presented in tabular form. Magnetic measurements included, in addition to the usual experiments, temperature dependence data. Of the many garnet compositions investigated, lanthanum europium thulium gallium iron garnet and samarium thulium gallium iron garnet exhibited percentage changes over the -55 to +125 C temperature range which are well within the contract specified limits. The q for these films was found to be 5 to 6, as compared to the design goal minimum value of 3. Therefore, since all static small bubble diameter properties of these two LPE film compositions more than meet the contract objectives, the program will proceed with the measurement of their dynamic magnetic properties. Author (GRA)

N78-19989# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

DEPTH-RESOLVED CATHODOLUMINESCENCE OF CARBON IMPLANTED GALLIUM ARSENIDE M.S. Thesis

Martin J. Walter Dec. 1977 68 p refs

(AD-A048970; AFIT/GEP/PH/77-15) Avail: NTIS HC A04/MF A01 CSCL 20/12

The effects of two caps, SiO2 and Si3N, are examined on Cr doped GaAs by means of depth resolved Cathodoluminescence. The GaAs samples had been implanted with C in fluences of 10 to the -13th power/sq cm and 10 to the -14th power/sq cm. Two of the samples differed only in the cap used. The energy shift in the carbon-carbon, donor-acceptor, recombination, and the free-bound, carbon acceptor transition peak are used to evaluate the carbon donor, and carbon acceptor concentrations. These concentrations are used to evaluate the effects of the caps. It is found that the carbon substitutes for both Ga and As; and that the Si3N4 cap permits greater outdiffusion of As than the SiO2 cap; and that the SiO2 cap permits greater outdiffusion of the Ga than does the Si3N4 cap. Author (GRA)

N78-19990# Montana State Univ., Bozeman. Dept. of Physics.

ANGULAR-RESOLVED ELECTRON EMISSION STUDIES OF MICROWAVE MATERIALS Final Scientific Report, 1 Jul. 1975 - 30 Jun. 1977

Gerald J. Lapeyre 30 Jun. 1977 18 p refs

(Grant AF-AFOSR-2872-75)

(AD-A049326; AFOSR-77-1296TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

The purpose of our program is to investigate the electronic properties of bulk solids, surfaces of solids, and adsorbed molecules on solid surfaces using the newly-developed method of polarization-dependent angle-resolved ultraviolet photoemission spectroscopy (PARUPS). The program utilizes the unique properties of synchrotron radiation emitted from the Wisconsin storage ring which forms an intense continuum which extends well past 200 eV in energy. The portion of this continuum we have used depends on our monochromator and extends from 6 eV to about 40 eV. It is possible to take data at any selected photon energy in this range, as well as to do so while varying the photon energy continuously. The radiation is linearly polarized so it is possible to study photoemission effects which depend on the orientation of the polarization vector with respect to the crystal axes of the sample. Such data enables one to draw inferences about the electronic structure, wave function symmetry and, in certain cases, the orientation of adsorbed molecules. GRA

N78-19991# Interactive Radiation, Inc., Northvale, N. J.

HIGH PERFORMANCE PYROELECTRIC MATERIALS Final Report, Feb. 1975 - Jun. 1977

Warren Ruderman Jun. 1977 86 p refs

(Contract DAAK02-75-C-0131)

(AD-A049204) Avail: NTIS HC A05/MF A01 CSCL 20/2

Single crystals of triglycine sulfate (TGS), triglycine fluoberyllate (TGFB), deuterated triglycine fluoberyllate (D-TGFB), triglycine selenate (TGSe), mixed crystals of TGS and TGSe and 1-alanine doped TGS and TGFB were grown and characterized. Optimum crystal growth conditions were established. In particular, for D-TGFB which has the highest figure of merit, best crystal growth was obtained at a starting saturation temperature of 45 degrees, a seed rotation rate of 15 rpm, a pH of 3.6, a growth rate of 0.1 degrees per day for a volume of 10 liters, and a seed orientation in which the cleavage plane was parallel to the horizontal plane. Careful measurements were made of the pyroelectric coefficient and dielectric constant of a large number of samples of these homologs of TGS and consistent values were obtained. The superior figure of merit of D-TGFB was confirmed. The production of thin pyroelectric crystal targets by optical polishing and cup-etching was investigated. Author (GRA)

N78-19992# California Univ., Berkeley. Dept. of Physics.

POINT CONTACT JOSEPHSON MIXERS AT 130 GHz Technical Report, 1 Feb. 1977 - 31 Jan. 1978

John H. Classen and Paul L. Richards Oct. 1977 48 p refs

(Contract N00014-75-C-0496)

(AD-A049292) Avail: NTIS HC A03/MF A01 CSCL 09/5

The properties of point contact Josephson junctions operated as mixers with an external local oscillator at 130 GHz have been studied, and the results compared with predictions of the resistively shunted junction model. It was found that the junctions output noise could be within a factor 1.5 of the model prediction based on thermal driving noise. When the coupling to the RF source was optimized, a factor two discrepancy was typical. The measured conversion efficiency agreed with the model, within the experimental uncertainty in the equivalent microwave circuit. The best coupling was achieved in full-height waveguide. The best overall performance, measured using the hot/cold source technique, was a single side band conversion efficiency of 0.30 and mixer noise temperature of 180 K (both + or - 20%). The best junctions were made of Nb, with carefully prepared points. Nonideal behavior in other junctions is ascribed to heating effects. There is some evidence that junctions whose resistance exceeds a threshold value of approx. 60 ohms are no longer well described by the RSJ model. A discussion is given of possible improvements in peRFormance with better junctions or improved RF matching. Author (GRA)

N78-19993# Naval Research Lab., Washington, D. C. Radiation Effects Branch.

GENERATION OF INTERMODULATION BY ELECTRON TUNNELING THROUGH ALUMINUM OXIDE FILMS Final Report

C. D. Bond, C. S. Guenzer, and C. A. Carosella 26 Oct. 1977 29 p refs

(AD-A049113; AD-E000062; NRL-8170) Avail: NTIS HC A03/MF A01 CSCL 20/12

In the Navy's Fleet Satellite Communication System (FLTSATCOM) the existence of nonlinear conduction mechanisms in passive hardware components has resulted in the generation of intermodulation (frequency mixing) which degrades the system performance. Consequently there is an urgent need for a systematic investigation of the basic mechanisms that can produce intermodulation. This report describes an investigation of the generation of RF intermodulation due to nonlinear conduction by electron tunneling through thin-film aluminum oxide junctions. Details are presented regarding the fabrication of junctions, their current-voltage characteristics, and the measurement of intermodulation power levels. The measured ratio of intermodulation power to signal power was 10 to the minus 15th power to 10 to the minus 11th power, which is significantly higher than the desired 10 to the minus 19th power. The measured intermodulation levels are correlated with the device circuit parameters and with existing tunneling theory. In addition the report describes some preliminary results of efforts to improve the conduction characteristics of such junctions by ion implantation. Initial implantation results with silver atoms are sufficiently promising to warrant further investigation with different atoms, greater implantation depths, and higher fluences. GRA

N78-19994# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE STATISTICAL THEORY OF THE SCALE FACTOR

T. A. Kontorova 29 Jul. 1977 26 p refs Transl. into ENGLISH from Sbornik Dokl. po Dinamicheskoy Prochnosti Detaley Mashin (USSR), 1964 p 178-184

(AD-A049265; FTD-ID(RS)T-1263-77) Avail: NTIS HC A03/MF A01 CSCL 20/2

Conditions which determine the ductile-to-brittle transition temperature in crystals and the tendency of steel samples toward brittle fracture were studied. The maximum and minimum brittleness boundaries, and the boundaries of the region of most frequently encountered values of brittle strength were determined. Numerical ratios were used to determine the position of the boundary of the brittleness transformation range from the size of the samples. The transformation range of brittleness is shown to become narrower with an increase in the size of the samples. A.R.H.

N78-19995# California Univ., Berkeley. Lawrence Berkeley Lab.

MICROSTRUCTURE AND MAGNETO-ACOUSTIC OSCILLATIONS OF (Cu, Co) NICKEL FERRITE

Raja K. Mishra and G. Thomas Jun. 1977 15 p refs Presented at Intern. Magnetic Conf., Los Angeles, Calif., 6-9 Jun. 1977

(Contract W-7405-eng-48; Contract W-7403-eng-48)

(LBL-6095; Conf-770638-3) Avail: NTIS HC A02/MF A01

The effects of microstructural features as revealed by scanning and transmission electron microscopy on the magnetostrictive vibration of Cu and Co doped nickel ferrite are studied. Results show that changes in the grain boundary are strongly coupled with the geometry of the pores and the two features are not separable. The magneto-mechanical coupling coefficient is seen to depend strongly on the grain size. However, it appears that the pore structure and not the grain size is the important microstructural parameter that affects this magnetic property. Effects of microstructural features such as stacking faults, dislocations, and nickel phosphide precipitates on grain boundaries are shown to be secondary in importance. ERA

N78-19996# Hanford Engineering Development Lab., Richland, Wash.

THEORETICAL PREDICTION OF MICROSTRUCTURAL DEVELOPMENT DURING IRRADIATION

R. W. Powell May 1977 30 p refs Presented at the Intern. Conf. on Radiator Effects in Breeder Reactor Structural Mater., Scottsdale, Ariz., 19-23 Jun. 1977

(Contract EY-76-C-14-2170)

(HEDL-SA-1157; Conf-770641-11) Avail: NTIS HC A03/MF A01

The formation and growth of dislocation loops, voids, and network dislocations during irradiation were modeled. The dislocation loop density, average dislocation loop size, total dislocation density, void number density and average void size were calculated as functions of temperature and dose. Applications of the model include analysis of proposed swelling mechanisms and guidance in performing swelling simulation experiments. The predicted effects that changes in the stacking fault energy, surface energy, shear modulus and vacancy migration energy would have on the evolving microstructure are presented. Preconditioned specimen simulation experiments are analyzed and a recommended indicator that the desired conditions have been achieved is discussed. ERA

N78-19997# Los Alamos Scientific Lab., N. Mex.

ZERO AND LOW COEFFICIENT OF THERMAL EXPANSION POLYCRYSTALLINE OXIDES

S. R. Skaggs Sep. 1977 12 p refs

(Contract W-7405-eng-36)

(LA-6918-MS) Avail: NTIS HC A02/MF A01

Polycrystalline oxide systems with zero to low coefficient of thermal expansion (CTE) investigated include hafnia-titania and hafnia. The CTE for 30 to 40 mol% TiO2 in HfO2 is less than or equal to 1 x 10 to the minus 6 power C, while for other compositions in the range 25 to 60 mol% it is approximately 4 x 10 to the minus 6 power C. An investigation of the CTE of 99.999% HfO2 yielded a value of 4.6 x 10 to the minus 6 power C from room temperature to 1000 C. Correlation with data on HfO2 by other investigators shows a definite relationship between the CTE and the amount of ZrO2 present. Data are listed for comparison of the CTE of several other polycrystalline oxides investigated at Oak Ridge. ERA

N78-19998# Brookhaven National Lab., Upton, N. Y.

CRYSTALLOGRAPHIC INVESTIGATIONS ON POLYHYDRIDE METAL COMPLEXES

R. Bau, W. E. Carroll, D. W. Hart, R. G. Teller, and T. F. Koetzle 1977 41 p refs Presented at the Am. Chem. Soc. Meeting, Montreal, May 1977 Prepared in cooperation with Univ. of Southern Calif., Los Angeles

(Contract EY-76-C-02-0016)

(BNL-22995; Conf-770510-9) Avail: NTIS HC A03/MF A01

The molecular structures of four transition metal polyhydride complexes were reported by X-ray diffraction analysis and by neutron diffraction analysis. The arrangement of phosphorus atoms about the Ir atom suggested a distorted octahedral geometry for this molecule. The X-ray analysis of H7Re(PMe2Ph)2 revealed a bent P-Re-P backbone for the molecule which was consistent with a tricapped trigonal prism with P atoms in equatorial positions. The neutron diffraction analysis of H4Os(PMe2Ph)3 shows that the molecule was a distorted pentagonal bipyramid, with one equatorial and two axial phosphine ligands. The neutron diffraction analysis of the H8Re2(PEt2Ph)4 dimer revealed a molecule with four terminal and four bridging hydride ligands. This molecule provides the first example of a metal-metal bond bridged by four hydrogen atoms. ERA

N78-19999# Ames Lab., Iowa.

SELF-CONSISTENT, RELATIVISTIC, FERROMAGNETIC BAND STRUCTURE OF GADOLINIUM

B. N. Harmon, J. Schirber (Sandia Labs., Albuquerque, N. Mex. and D. D. Koelling (Argonne Natl. Lab.) 1977 8 p refs

(Contract EY-76-C-04-0789)

(SAND-77-1260C; Conf-770827-5) Avail: NTIS HC A02/MF A01

An initial self-consistent calculation of the ground state magnetic band structure of gadolinium is described. A linearized APW method was used which included all single particle relativistic effects except spin-orbit coupling. The spin polarized potential was obtained in the muffin-tin form using the local spin density approximation for exchange and correlation. The most striking and unorthodox aspect of the results is the position of the 4f spin-down bands which are required to float just on top of the Fermi level in order to obtain convergence. If the 4f states (1 = 3 resonance) are removed from the occupied region of the conduction bands the magnetic moment is approximately .75 micron/sub B//atom; however, as the 4f spin-down states are allowed to find their own position they hybridize with the conduction bands at the Fermi level and the moment becomes smaller. Means of improving the calculation are discussed. ERA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

N78-20000 Engineering Sciences Data Unit, London (England).

THERMAL CONDUCTIVITY, VISCOSITY, HEAT CAPACITY, DENSITY AND PRANDTL NUMBER OF SEA WATER AND ITS CONCENTRATES

Oct. 1977 16 p

(ESDU-77024; ISBN-0-85679-196-2) For information on availability of series, sub-series, and other individual data items, write NTIS, attn: ESDU, Springfield, Va. 22161

The data cover a wide range of both temperature and concentration. The concentration of sea water samples was normally defined by a single term, either salinity or chlorinity. This is possible since for all practical purposes the relative composition of sea water was constant. This did not imply that all samples did the same composition but merely that all ions were present in the same ratios and that the only variation was th amount of pure water present. The major components of sea water are given at its normal salinity of 35 parts per thousand

though samples from different seas varied by more than the range 32 to 40 parts per thousand. Author

N78-20001 Engineering Sciences Data Unit, London (England).
HEAT CAPACITY AND ENTHALPY OF LIQUIDS: ALKANES
Oct. 1977 23 p
(ESDU-77025; ISBN-0-85679-197-0) For information on availability of series, sub-series, and other individual data items, write NTIS, attn: ESDU, Springfield, Va. 22161

Values of saturated liquid heat capacity and enthalpy are presented in tabular form for the straight and branched chain alkanes. For most compounds the range covered was from the melting point to the normal boiling point or to the limit of the experimental data. The procedure used to obtain the values of heat capacity is presented, and the effect of pressure is indicated. Values of enthalpy were derived from values of heat capacity. Author

N78-20002 Syracuse Univ., N. Y.
QUANTUM FIELD THEORY IN HOMOGENEOUS SPACES Ph.D. Thesis
Francisco Javier Chinea-Trujillo 1977 87 p
Avail: Univ. Microfilms Order No. 77-30714

The formulation of quantum field theory on curved spaces was developed along group theoretic lines. The background space-time was assumed to be a pseudo-Riemannian homogeneous space of a transitive isometry group. The quantization of the scalar field is related to the representation theory of the underlying group of isometries; in particular, the quantization procedure is shown to be determined by the decomposition of the quasi-regular representation of the group into irreducible unitary representations. The general properties of invariant kernels on groups and homogeneous spaces were studied, relating them to the zonal spherical functions on the group. Dissert. Abstr.

N78-20003# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.
THERMODYNAMICS OF ORGANIC COMPOUNDS Final Report, 1 Oct. 1976 - 30 Sep. 1977
William D. Good, Donald W. Scott, Norris K. Smith, and Ann G. Osborn 30 Sep. 1977 20 p refs
(Grant AF-AFOSR-ISSA-77-0002; AF Proj. 2308)
(AD-A049198; AFOSR-77-1308TR) Avail: NTIS HC A02/MF A01 CSCL 07/3

Research continued on hydrocarbons with unusual strained bridging bonds that may contribute knowledge needed to tailor organic molecules having good energy/volume or energy/mass characteristics. Three compounds were studied containing the 'cyclo-buta' bridge, a study commenced in FY 76. A study was begun on certain alkylnaphthalenes and indans in which high steric interaction energy should contribute to high enthalpy of combustion. Two ram-jet fuels were studied, fuels already in use. Author (GRA)

N78-20004# California Univ., Livermore. Lawrence Livermore Lab. Dept. of Chemistry.
IONIC INTERACTIONS IN TRANSPORT PROCESSES AS DESCRIBED BY IRREVERSIBLE THERMODYNAMICS
Donald G. Miller 21 Jun. 1977 23 p refs Presented at Discussions of the Faraday Soc., Oxford, Engl., 13-15 Sep. 1977
(UCRL-79624; Conf-770919-1) Avail: NTIS HC A02/MF A01

The application of irreversible thermodynamics to transport in electrolyte solution is reviewed. The linear Onsager coefficient 1 sub ij should provide a general and more fundamental insight into ion-ion and ion-solvent interactions than special case coefficients like the conductance. The implications of nonzero 1 sub ij, i does not equal j, are discussed. Selected 1 sub ij values for binary and ternary systems are presented, including new results for CuSO4. Estimation methods for 1 sub ij of ternary and higher order systems are also considered. ERA

N78-20005# Columbia Univ., New York. Dept. of Physics.
REGULARIZATION AND RENORMALIZATION OF QUANTUM FIELD THEORY IN CURVED SPACE-TIME
Claude Bernard and Arthur Duncan (Inst. for Advanced Study) Jan. 1977 38 p refs
(Contract EY-76-S-02-2220)
(COO-2220-97) Avail: NTIS HC A03/MF A01

It is proposed that field theories quantized in a curved spacetime manifold can be conveniently regularized and renormalized with the aid of Pauli-Villars regulator fields. The method avoids the conceptual difficulties of covariant point-separation approaches, by starting always from a manifestly generally covariant action, and the technical limitations of the dimensional regularization approach, which requires solution of the theory in arbitrary dimension in order to go beyond a weak-field expansion. An action is constructed which renormalizes the weak-field perturbation theory of a massive scalar field in two space-time dimensions-it is shown that the trace anomaly previously found in dimensional regularization and some point-separation calculations also arises in perturbation theory when the theory is Pauli-Villars regulated. One then studies a specific solvable two-dimensional model of a massive scalar field in a Robertson-Walker asymptotically flat universe. It is shown that the action previously considered leads, in this model, to a well defined finite expectation value for the stress-energy tensor. ERA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N78-20006*# National Aeronautics and Space Administration, Washington, D. C.
NASA'S UNIVERSITY PROGRAM: ACTIVE GRANTS AND RESEARCH CONTRACTS, FISCAL YEAR 1977
1977 328 p
(NASA-TM-79325) Avail: NTIS HC A15/MF A01 CSCL 05A

As basic policy NASA believes that colleges and universities should be encouraged to participate in the nation's space and aeronautics program to the maximum extent practicable. The Office of University Affairs (OUA) serves as a focal point for NASA's relationships with colleges and universities. One of its roles is to provide information on the NASA University Program. The present document is designed to serve several purposes and a wide range of audiences from private individuals to NASA employees. The emphasis is on the technical content of the program, rather than on fiscal data, which is available separately from OUA. As some terminology will not be familiar to all readers, a User's Guide is included to facilitate the fullest use of the material related to the interests of any particular reader. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N78-20007# Texas Univ., Austin. Center for Cybernetic Studies.
MEASURING THE EFFICIENCY OF DECISION MAKING UNITS WITH SOME NEW PRODUCTION FUNCTIONS AND ESTIMATION METHODS
A. Charnes, W. W. Cooper (Harvard Univ., Cambridge, Mass.), and E. Rhodes (Carnegie-Mellon Univ.) Aug. 1977 63 p refs
(Contracts N00014-75-C-0616; N00014-75-C-0569; N00014-76-C-0932; Grant NSF SOC-76-15876; NR Proj. 047-021)
(AD-A049149; CCS-308) Avail: NTIS HC A04/MF A01 CSCL 05/3

A series of linear programming models are used to clarify and extend a measure of efficiency. The duals to these models are shown to yield estimates of production coefficients from the same empirical data and computations that yield the measures of efficiency. The nature of the resulting production functions and ways in which they differ from more customary ones are discussed en route to synthesizing the associated cost functions and other such (economic) relations. Methods for adjusting observations are suggested for economic inferences and policy applications. Multiple output-multiple input extensions are effected

via a new definition of efficiency which involves a nonlinear model for determining the optimal input and output weights from observational data. The theory of fractional programming is used to secure ordinary linear programming models from which the weights and efficiency measures may also be obtained. GRA

N78-20008# Washington Univ., Seattle. Dept. of Psychology.
AN EXPERIMENTAL TEST OF A MODEL FOR DECISION STRATEGY SELECTION
Jay J. J. Christensen-Szalanski Dec. 1977 26 p refs
(Contract N00014-76-C-0193)
(AD-A049148; TR-77-14) Avail: NTIS HC A03/MF A01 CSCL 05/10

Beach and Mitchell (1977) proposed a contingency model for the selection of decision strategies. The strategy that the decision maker sees as offering the greatest expected net gain is the one selected; i.e., selection is based on a cost-benefit analysis. Christensen-Szalanski and Beach (1977) formalized the strategy selection mechanism. The present paper reports on the tests of the major predictions of the formalized model. The results strongly support the model's predictions: (1) of the effect that fatigue and an increase in the value of making a correct decision will have upon the decision maker's confidence in the decision and the amount of time invested in making the decision, and (2) the assumption that strategy cost is an increasing function of perceived strategy selection. In addition (3) a significant correlation was obtained between subjective certainty and obtained accuracy of the decisions, and (4) the value of making a correct decision was found to affect the complexity of the strategy selected to solve the decision. The results suggest that people use a form of cost-benefit analysis as a basis for selecting decision strategies and that their behavior is optimal in that it tends to maximize the decision maker's expected net utility.
Author (GRA)

N78-20009# Decisions and Designs, Inc., McLean, Va.
HANDBOOK FOR DECISION ANALYSIS
Scott Barclay, Rex V. Brown, Clinton W. Kelly, III, Cameron R. Peterson, and Lawrence D. Phillips Sep. 1977 284 p refs
(Contract N00014-76-C-0074; ARPA Order 3052)
(AD-A049221; TR-77-6-30) Avail: NTIS HC A13/MF A01 CSCL 05/10

This handbook is intended to provide decision makers and their staffs (current or potential) with an introduction to the basic concepts and operations of decision analysis. Decision analysis is a quantitative method which permits the systematic evaluation of the costs or benefits accruing to courses of action that might be taken in a decision problem. It entails identification of the alternative choices involved, the assignment of values (costs/benefits) for possible outcomes, and the expression of the probability of those outcomes being realized. With this information at hand, one can then systematically combine the values and probabilities to show the probable gain or loss that is associated with alternative choices. GRA

N78-20010# Army Research and Technology Labs., Moffett Field, Calif.
ARMY AVIATION RDT AND E PLAN, SIXTH EDITION
Oct. 1977 372 p
(AD-A049214) Avail: NTIS HC A16/MF A01 CSCL 01/3

This Plan presents a time-phased analysis and presentation of the scientific and technological R/D efforts required to support the development of advanced airmobile systems responsive to the future needs of the Army. Plans and objectives are set forth for Army aviation research and development activities for FY78-97, with emphasis on the period from the present to 1982. Current R/D efforts in Army air mobility are directed primarily toward the development of a family of aircraft capable of vertical and short takeoffs and landings. These aircraft will fulfill identified requirements in the land combat functions of mobility, intelligence, firepower, combat service support, and command, control, and communications. The Airmobile Systems section of the Plan is aligned to present the operational systems, developing systems, and R/D planning concepts as an element of the land combat functions of mobility, intelligence, firepower, combat service support, and command, control and communication rather than as individual systems. The Technology sections present the research effort needed, assuming no constraints on resources, to develop the technology base necessary to support the airmobile system concepts. The Technology sections also provide a discussion of program planning and include the philosophy for the development of technical thrusts for the individual technologies. The Plan covers RDT/E activities (6.1 through 6.7 program categories) and also MM/T activities, which are normally part of Procurement of Equipment and Missiles-Army (PEMA). GRA

N78-20011# Army Research and Technology Labs., Moffett Field, Calif.
ARMY RESEARCH AND TECHNOLOGY LABORATORIES, FY 1977 Annual Report
1977 54 p
(AD-A049212) Avail: NTIS HC A04/MF A01 CSCL 01/3

The U.S. Army Research and Technology Laboratories (RTL) perform the air mobility R and D efforts of the U.S. Army Aviation Research and Development Command (AVRADCOM). The capabilities of their staff of research, engineering, and support personnel span the sciences, disciplines, and technologies of Army aviation. GRA

N78-20012# Army Research and Technology Labs., Moffett Field, Calif.
ARMY AVIATION RDT AND E PLAN. SIXTH EDITION. EXECUTIVE SUMMARY
Oct. 1977 23 p
(AD-A049213) Avail: NTIS HC A02/MF A01 CSCL 01/3

For abstract, see N78-20010.

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N78-20013*+ National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SCIENTIFIC AND TECHNICAL INFORMATION OUTPUT OF THE LANGLEY RESEARCH CENTER
1977 107 p
(NASA-TM-79405) Avail: NTIS HC A06 CSCL 05B

A compilation of the Scientific and Technical Information that the Langley Research Center produced during the calendar year of 1977 is presented. Included in this listing are NASA Reference Papers, Technical Notes, Technical Papers, Technical Memorandums, Special Publications, Conference Publications, Contractor Report, Journal Articles, and Technical Presentations made at Society meetings. NASA formal reports included in this listing are those that were mailed and distributed to the ultimate user. In selecting Journal Articles, only those articles which were published in a Journal during the past calendar year are included. Similarly, material presented at Society meetings was presented during the calendar year 1977. Author

N78-20014*+ National Aeronautics and Space Administration, Washington, D. C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY, JULY 1: ABSTRACTS, SUPPLEMENT 11
Jul. 1977 80 p
(NASA-SP-7039(11)-Section-1) Avail: NTIS E04 CSCL 05B

This continuing bibliography lists 197 patents and patent applications introduced into the NASA scientific and technical information system from January through June 1977. Each entry consists of a citation, an abstract, and, in most cases, a key illustration selected from the document. Author

N78-20015# Mitre Corp., Bedford, Mass.
MULTIMODE INFORMATION DISTRIBUTION SYSTEM (MIDS)
G. T. Delaney, G. C. Dempsey, S. J. Forde, C. W. Kleekamp, B. D. Metcalf, J. W. F. Ye, and J. Yokoff Dec. 1977 293 p refs

(Contract F19628-76-C-0001; AF Proj. 7040)
(AD-A048639; MTR-3367; ESD-TR-77-260) Avail: NTIS HC A13/MF A01 CSCL 17/2

The Multimode Information Distribution System (MIDS) is an advanced, local area communication system capable of simultaneously handling audio, video, and digital data traffic for a large number of subscribers. The MIDS configuration utilizes a broadband coaxial cable transmission medium such as that used by the CATV industry. The prototype MIDS serves to demonstrate proof of concepts for flag-for-service signaling and supervision as well as an adaptive data rate transmission scheme. GRA

N78-20016# Harry Diamond Labs., Washington, D.C.
DIGITAL REPRESENTATIONS OF ENGINEERING DRAWINGS
David J. Buscher Nov. 1977 26 p refs
(DA Proj. 1T8-65803-M-728)
(AD-A048277; HDL-TR-1834) Avail: NTIS HC A03/MF A01 CSCL 05/2

Methods for producing the digital representation of engineering drawings are discussed. Particular attention is paid to the interactive creation of such drawings with computer-controlled drafting and design equipment and the automatic scanning of existing drawings. Hardware, software, and human interaction for interactive and scanning methods are discussed, with comments on where the systems are now and how they need to be improved in the future. Author (GRA)

N78-20017# SRI International Corp., Menlo Park, Calif.
MECHANICAL INTELLIGENCE: RESEARCH AND APPLICATIONS Final Technical Report, 12 Apr. 1976 - 9 Oct. 1977
Earl D. Sacerdoti, Richard E. Fikes, Gary G. Hendrix, Paul Morris, and Daniel Sagalowicz Nov. 1977 167 p refs
(Contract DAAG29-76-C-0012; ARPA Order 2694)
(AD-A049027) Avail: NTIS HC A08/MF A01 CSCL 05/2

This report summarizes the results of a research project whose goal is to develop computer systems that can provide easy access for nontechnicians to large, distributed data bases of information. Our goal has been to develop mechanisms for automating many of the detailed tasks that today are normally performed by a decision maker's technical staff. These include accepting a question, in natural (not necessarily grammatical) English, in the decision maker's own terms; planning a sequence of queries to various files to gather the requested information; developing the plan into a computer program or programs in the language of the data base management system on which the data resides; transmitting the retrieval programs, and monitoring their execution; and composing the information retrieved into a suitable output format. We have focused our efforts along two mutually supporting lines of research. First, we have created a performance system, called LADDER (for Language Access to Distributed Data with Error Recovery), that carries out all of the functions listed above in at least rudimentary form. Our second line of research focuses on longer-term efforts to develop the techniques required to satisfy more fully the needs of decision makers. GRA

N78-20018# Du Pont de Nemours (E. I.) and Co., Aiken, S. C.
EXTENSIONS TO THE JOSHUA GDMS TO SUPPORT ENVIRONMENTAL SCIENCE AND ANALYSIS DATA HANDLING REQUIREMENTS
J. E. Suich and H. C. Honeck 1977 11 p refs Presented at Symp. on Systems and Decision Sci., Berkeley, Calif., 5-7 Oct. 1977
(Contract EY-76-C-09-0001)
(DP-MS-77-84; Conf-771005-2) Avail: NTIS HC A02/MF A01

A generalized data management system (GDMS) called JOSHUA has been in use at the Savannah River Laboratory. Originally designed and implemented to support nuclear reactor physics and safety computational applications, the system is now also supporting environmental science modeling and impact assessment. Extensions to the original system are being developed to meet new data handling requirements, which include more general owner-member record relationships occurring in geographically encoded data sets, unstructured (relational) inquiry capability, cartographic analysis and display, and offsite data exchange. This paper discusses the need for these capabilities, places them in perspective as generic scientific data management activities, and presents the planned context-free extensions to the basic JOSHUA GDMS. ERA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N78-20019 Catholic Univ. of America, Washington, D. C.
THE APPLICABILITY OF PYROLYSIS-GAS-LIQUID CHROMATOGRAPHY FOR THE QUANTITATIVE IDENTIFICATION OF BACTERIA IN SEWAGE TREATMENT PLANT EFFLUENT Ph.D. Thesis
Richard Aloysius Symuleski 1977 166 p
Avail: Univ. Microfilms Order No. 77-29184

Research aimed at developing an on line process instrument for the identification of bacteria in the aqueous phase was discussed. Pyrolysis-gas-liquid chromatography (PGLC) was used to shorten the analysis time for bacteria from the 24 to 72 hours required by conventional methods to approximately 1 to 2 hours. Results indicate that PGLC signatures of wet bacterial cells were unique at the strain level and can be detected at a lower limit of approximately 80 colony forming units per 100 ml. The PGLC signatures of individual species were found to be independent of media composition. A computer program was developed to match the bacteria present in a sample with signatures of species recorded in a data file. Dissert. Abstr.

N78-20020*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FULLY AUTOMATED URBAN TRAFFIC SYSTEM Final Report, Jul. 1976 - Aug. 1977
B. M. Dobrotin, G. R. Hansen, T. K. C. Peng, and D. A. Rennels Dec. 1977 126 p refs Sponsored in part by NASA
(Contract DOT-AS-60067)
(NASA-CR-155947; JPL-Pub-77-64; DOT-TST-78-3) Avail: NTIS HC A07/MF A01 CSCL 13F

The replacement of the driver with an automatic system which could perform the functions of guiding and routing a vehicle with a human's capability of responding to changing traffic demands was discussed. The problem was divided into four technological areas; guidance, routing, computing, and communications. It was determined that the latter three areas being developed independent of any need for fully automated urban traffic. A guidance system that would meet system requirements was not being developed but was technically feasible. Author

N78-20021*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BASELINE TESTS OF THE VOLKSWAGEN TRANSPORTER ELECTRIC DELIVERY VAN
Richard F. Soltis, Edward McBrien, John M. Bozek, and Francis Gourash Jan. 1978 56 p refs
(Contract EC-77-A-31-1011)
(NASA-TM-73766; CONS/1011-11; E-9506) Avail: NTIS HC A04/MF A01 CSCL 13F

The Volkswagen Transporter, an electric delivery van, was tested as part of an Energy Research and Development Administration (ERDA) project to characterize the state of the art of electric vehicles. The Volkswagen Transporter is a standard Volkswagen van that has been converted to an electric vehicle. It is powered by a 144-volt traction battery. A direct current (dc) chopper controller, actuated by a conventional accelerator pedal, regulates the voltage or power applied to the 16-kilowatt (21-hp) motor. The braking system uses conventional hydraulic braking in combination with an electric regenerative braking system. The Volkswagen vehicle performance test results are presented. Author

N78-20022*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF CONVENTIONALLY POWERED VEHICLES TESTED TO AN ELECTRIC VEHICLE TEST PROCEDURE
Ralph J. Slavik, Miles O. Dustin, and Stacy Lumannick Dec. 1977 62 p refs
(Contract EC-77-A-31-1011)
(NASA-TM-73768; E-9482; CONS/1011-13) Avail: NTIS HC A04/MF A01 CSCL 13F

A conventional Volkswagen transporter, a Renault 5, a Pacer, and a U. S. Postal Service general DJ-5 delivery van were treated to an electric vehicle test procedure in order to allow direct comparison of conventional and electric vehicles. Performance test results for the four vehicles are presented. Author

N78-20023*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESPONSE OF LEAD-ACID BATTERIES TO CHOPPER-CONTROLLED DISCHARGE: PRELIMINARY RESULTS
Robert L. Cataldo Feb. 1978 9 p refs
(Contract EC-77-31-1044)
(NASA-TM-73834; CONS/1044-1; E-9421) Avail: NTIS HC A02/MF A01 CSCL 10C

The preliminary results of simulated electric vehicle, chopper, speed controller discharge of a battery show energy output losses up to 25 percent compared to constant current discharges at the same average discharge current of 100 amperes. These energy losses are manifested as temperature rises during discharge, amounting to a two-fold increase for a 400-ampere pulse compared to the constant current case. Because of the potentially large energy inefficiency, the results suggest that electric vehicle battery/speed controller interaction must be carefully considered in vehicle design. Author

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N78-20024*# Princeton Univ. Observatory, N. J.
THE COPERNICUS ULTRAVIOLET SPECTRAL ATLAS TAU SCORPII
John B. Rogerson, Jr. and Walter L. Upson, II Sep. 1977 75 p refs Repr. from The Astrophys. J. Suppl. Series, v. 37, Sept. 1977 p 37-110
(Contract NAS5-1810)
(NASA-CR-156690) Avail: NTIS HC A04/MF A01 CSCL 03A

An ultraviolet spectral atlas was presented for the B0 V star, Tau Scorpii. It was scanned from 949 to 1560 A by the Princeton spectrometer aboard the Copernicus satellite. From 949 to 1420 A the observations have a nominal resolution of 0.05 A. At the longer wavelengths, the resolution was 0.1 A. The atlas was presented in both tables and graphs. Author

N78-20025 New Mexico State Univ., University Park.
BALMER EMISSION LINES IN T TAURI-LIKE DECELERATING FLOWS Ph.D. Thesis
Timothy James Schneeberger 1978 167 p
Avail: Univ. Microfilms Order No. 77-32066

The star and envelope properties are chosen to approximate T Tauri star conditions. The Sobolev approximation is used to solve the radiative transfer problem in the envelope and the application of this technique to decelerating atmospheres is discussed. A ten-level model hydrogen atom including forty-five line transitions is utilized and the effects of changes in the adopted collisional cross sections and recombination rates are determined. The details of the solutions of the hydrogen level populations are presented for a range of envelope conditions. The effects of changes in the effective temperature of the central star, the electron temperature of the envelope, the stellar mass loss ratio and the initial flow velocity in the decelerating envelope are discussed. The Balmer line profiles are computed by integrations along surfaces of equal line of sight velocity. Changes in emission line strengths and shapes and the behavior of the Balmer decrement were determined for a range of envelope conditions. Dissert. Abstr.

N78-20026 Case Western Reserve Univ., Cleveland, Ohio.
A SPECTROSCOPIC STUDY OF LITHIUM IN S STARS Ph.D. Thesis
Thomas Bellis Ake, III 1977 145 p
Avail: Univ. Microfilms Order No. 77-30971

Observations of 62 MS, S and C stars were made to investigate the variation of Li abundance with other compositional parameters. For each star, a high dispersion image tube spectrogram was taken and a low dispersion plate was obtained for classification purposes. The S stars were divided into five C/O classes on the basis of the relative strengths of TiO, YO and ZrO. The high dispersion plates were visually examined and estimates of line ratios were used to derive Li/Ca and Zr/Ti abundance indices by comparing the observations with published abundance determinations. Implications of the relationship between Li/Ca, Zr/Ti and C/O are discussed. Dissert. Abstr.

N78-20027*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
PROPOSAL TO NATIONAL AERONAUTICS AND SPACE ADMINISTRATION FOR CONTINUATION OF A GRAZING INCIDENCE IMAGING TELESCOPE FOR X-RAY ASTRONOMY USING SOUNDING ROCKETS
B. Murray Jan. 1976 52 p refs
(Grant NsG-5091)
(NASA-CR-156695; P-589-1-76) Avail: NTIS HC A04/MF A01 CSCL 03A

The construction of a high resolution imaging telescope experiment payload suitable for launch on an Astrobee F sounding rocket was proposed. Also integration, launch, and subsequent data analysis effort were included. The payload utilizes major component subassemblies from the HEAO-B satellite program which were nonflight development units for that program. These were the X ray mirror and high resolution imager brassboard detector. The properties of the mirror and detector were discussed. The availability of these items for a sounding rocket experiment were explored with the HEAO-B project office. Author

N78-20028*# Ball Bros. Research Corp., Boulder, Colo.
ALIGNMENT CONTROL STUDY FOR THE SOLAR OPTICAL TELESCOPE Final Report
Oct. 1976 115 p refs
(Contract NAS5-23402)

(NASA-CR-156700) Avail: NTIS HC A06/MF A01 CSCL 03A

Analysis of the alignment and focus errors than can be tolerated, methods of sensing such errors, and mechanisms to make the necessary corrections were addressed. Alternate approaches and their relative merits were considered. The results of this study indicate that adequate alignment control can be achieved. Author

N78-20029*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OBSERVATIONS OF LOW LUMINOSITY X-RAY SOURCES IN VELA-PUPPIS

S. H. Pravdo (Md. Univ. College Park), R. H. Becker (Md. Univ., College Park), E. A. Boldt, S. S. Holt, P. J. Erlemitsos, and J. H. Swank Feb. 1978 24 p refs Submitted for publication

(NASA-TM-78087) Avail: NTIS HC A02/MF A01 CSCL 03A

Results of a study of the X-ray emission from a small portion of the galactic plane near galactic longitude 260 deg are presented. This region contains at least six low luminosity X-ray sources within approximately 10 deg. of PSR0833-45, which is near the center of the Gum Nebula. The X-ray source associated with the Vela pulsar, 4U0833-45, is observed at twice its 4U catalogue intensity. The lack of X-ray pulsations at the pulsar period, the non thermal power law spectrum, and models of the X-ray come from an extended source approximately 1 deg in radius. The observation of a high temperature spectrum in a field of view containing only Puppis A among known sources has led to the discovery of a new OSO-8 source, OSO752-39. Other spectra from this region are discussed. Author

N78-20030*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OSO-8 X-RAY SPECTRA OF CLUSTERS OF GALAXIES. 1. OBSERVATIONS OF TWENTY CLUSTERS: PHYSICAL CORRELATIONS

R. F. Mushotzky, P. J. Serlemitsos, B. W. Smith, E. A. Boldt, and S. S. Holt Mar. 1978 55 p refs

(NASA-TM-78097) Avail: NTIS HC A04/MF A01 CSCL 03A

OSO-8 X-ray spectra from 2 to 20 keV were analyzed for 26 clusters of galaxies. Temperature, emission integrals, iron abundances, and low energy absorption measurements are given. Eight clusters have positive iron emission line detections at the 90% confidence level, and all twenty cluster spectra are consistent with Fe/H=0.000014 by number with the possible exception of Virgo. Physical correlations between X-ray spectral parameters and other cluster properties are examined. It is found that: (1) the X-ray temperature is approximately proportional to the square of the velocity dispersion of the galaxies; (2) the emission integral and therefore the bolometric X-ray luminosity is a strong function of the X-ray temperature; (3) the X-ray temperature and emission integral are better correlated with cluster central galaxy density than with richness; (4) temperature and emission integral are separately correlated with Rood-Sastry type; and (5) the fraction of galaxies which are spirals is correlated with the observed ram pressure in the cluster core. Author

N78-20031# Lincoln Lab., Mass. Inst. of Tech., Lexington.

A MODEL OF TELESCOPE MOUNT PERFORMANCE FOR REAL-TIME SYSTEM SIMULATIONS

Susan N. Landon 31 Oct. 1977 18 p

(Contract F19628-78-C-0002)

(AD-A048286; ETS-23; ESD-TR-77-273) Avail: NTIS HC A02/MF A01 CSCL 05/1

A computer simulation of the performance of the first GEODSS telescope was developed for the purpose of remote Real-Time System software development and operator training. In order to prove useful, this simulation had to provide a realistic approximation to the performance of the actual telescope. The telescope model used for this simulation is derived from the equations for linear motion and makes use of the measured telescope rate maxima and acceleration and deceleration rates. This model yields a simulation system performance that quite closely matches the behavior of the telescope. Although the tuning of the telescope driving must be done with the actual telescope, this model has provided a reliable vehicle for most other Real-Time System software development. Author (GRA)

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N78-20032*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.

LABORATORY SIMULATION OF INFRARED ASTROPHYSICAL FEATURES Ph.D. Thesis

Louis Allen Rose Aug. 1977 151 p refs

(Grant NsG-2014)

(NASA-CR-155939; Rept-16) Avail: NTIS HC A08/MF A01 CSCL 03B

Intermediate resolution emission spectroscopy was used to study a group of 9 terrestrial silicates, 1 synthetic silicate, 6 meteorites and 2 lunar soils; comparisons were made with the intermediate resolution spectra of Comet Kohoutek in order to determine which materials best simulate the 10um astrophysical feature. Mixtures of silicates which would yield spectra matching the spectrum of the comet in the 10um region include: (1) A hydrous layer lattice silicate in combination with a high temperature condensate; (2) an amorphous magnesium silicate in combination with a high temperature condensate and (3) glassy olivine and glassy anorthite in approximately equal proportions. Author

N78-20033*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

STRUCTURE OF CURRENT SHEETS IN MAGNETIC HOLES AT 1 AU

R. J. Fitzenreiter and L. F. Burlaga Feb. 1978 34 p refs Submitted for publication

(NASA-TM-78096) Avail: NTIS HC A03/MF A01 CSCL 03B

Current density profiles in several types of interplanetary magnetic holes were calculated assuming that the currents flow in planar sheets and that the magnetic field varies only in the direction normal to the sheet. The planarity was verified in four holes which were observed by two suitably spaced spacecraft. The structure of the current sheets ranges from very simple in some holes to very complex in others. The observed structures are found to be qualitatively consistent with models based on self-consistent solutions of Vlasov's equation and Maxwell's equations. Examples of complex, irregular magnetic holes are also presented, and they are shown to contain multiple, current sheets in which currents flow parallel to one another. Author

N78-20034*# San Jose State Univ., Calif.

ON THE ORIGIN OF EXTRATERRESTRIAL STRATOSPHERIC PARTICLES: INTERPLANETARY DUST OR METEOR ABLATION DEBRIS? M.S. Thesis

Frank T. Kyte Aug. 1977 82 p refs

(NCA2-OR675-612)

(NASA-CR-152075) Avail: NTiS HC A05/MF A01 CSCL 03B

Meteor ablation debris was distinguished from unablated interplanetary dust in a collection of extraterrestrial particles collected in the stratosphere using NASA U-2 aircraft. A 62 g sample of the Murchison (C2) meteorite was artificially ablated to characterize ablation debris for comparison with the stratospheric particles. By using proper experimental conditions, artificial ablation debris can be produced that is similar to natural ablation debris. Analyses of natural fusion crusts, artificial fusion crust, and artificial ablation debris of the Murchison meteorite produced criteria for recognizing debris ablated by a primitive meteoroid. Ninety-five percent of the stratospheric particles can be described as either ablation debris from a primitive meteoroid, or as very primitive interplanetary dust. Author

N78-20035# Los Alamos Scientific Lab., N. Mex.

THREE-DIMENSIONAL DYNAMICS OF PROTOSELLAR EVOLUTION Ph.D. Thesis

T. L. Cook Jun. 1977 287 p refs

(Contract W-7405-eng-36)

(LA-6841-T) Avail: NTIS HC A13/MF A01

A three dimensional finite difference numerical methodology was developed for self-gravitating, rotating gaseous systems. The fully nonlinear equations for time-varying fluid dynamics were

solved by a high speed computer in a cylindrical coordinate system rotating with an instantaneous angular velocity, selected such that the net angular momentum relative to the rotating frame was zero. The time dependent adiabatic collapse of gravitationally bound, rotating, protostellar clouds was studied for specified uniform and nonuniform initial conditions. ERA

N78-20036# Los Alamos Scientific Lab., N. Mex.
THERMAL X-RAYS AND DEUTERIUM PRODUCTION IN STELLAR FLARES
S. A. Colgate 1977 7 p refs Presented at the 15th Intern. Cosmic Ray Conf., Provdiv, Bulgaria, 13 Aug. 1977
(Contract W-7405-eng-36)
(LA-UR-77-1056; Conf-770808-1) Avail: NTIS HC A02/MF A01

The X-rays spectrum of flares is shown to be necessarily thermal up to greater than or equal to 200 keV because the self magnetic field of any electron stream required for a thick or thin target source is inconsistently large. The resulting flare model can then be related to stellar luminosity, convection and magnetic fields to result in a maximum possible gamma burst and continuous X-ray flux. One of the most striking isotopic anomalies observed is the extreme enrichment of helium in some solar flares and the mysterious depletion of deuterium. It is discussed how deuterium may be produced and emitted in the largest flares associated with gamma bursts. ERA

N78-20037# Los Alamos Scientific Lab., N. Mex.
MASS LOSS AND CEPHEID PULSATION
Cecil G. Davis, Jr. 1977 16 p refs Presented at 42nd IAU Colloq., Bamberg, West Ger., 6-9 Sep. 1977
(Contract W-7405-eng-36)
(LA-UR-77-1922; Conf-770924-1) Avail: NTIS HC A02/MF A01

Two purposes are served: to discuss the latest improvements in nonlinear pulsation theory indicating the ability to resolve features such as the Christy bump on the light curves and to show from the results of a bump model and recent observations that mass loss is one of the possible explanations for the mass discrepancy problem between evolutionary and pulsation theories. Recent observations show that extensive mass loss has occurred in the evolution of the M supergiant alpha Orionis. ERA

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N78-20038 Case Western Reserve Univ., Cleveland, Ohio.
THE ORBITS OF FIVE MINOR PLANETS AND CORRECTIONS TO THE FK4 EQUATOR AND EQUINOX Ph.D. Thesis
Richard Lacy Branham, Jr. 1977 97 p
Avail: Univ. Microfilms Order No. 77-30978

Because of their brightness and, hence, good observing histories, minor planets 6 (Hebe), 7 (Iris), 8 (Flora), 9 (Metis), and 15 (Eunomia) may be used to determine the zero-point errors of the fundamental astronomical reference system, that of the Fourth Fundamental Catalog (FK4). The astronomical literature yielded 14,584 observations in right ascension and 14,366 in declination of these minor planets. It was possible to reduce 73 percent of the observations to the FK4 by one of three methods: the construction of revised reference star apparent positions for the micrometer observations; the calculation of revised dependences for the photographic observations; or by the application of systematic catalog differences. Dissert. Abstr.

N78-20039 California Univ., Berkeley.
A MICROWAVE INTERFEROMETRIC STUDY OF THE SUB-SURFACE OF THE PLANET MERCURY Ph.D. Thesis
Leslie Morris Golden 1977 353 p
Avail: Univ. Microfilms Order No. 7731371

Analyses were made of extensive data on atmospheric emission and the decorrelation of microwave signals by the atmosphere. The model calculations incorporated both depth and temperature dependences of the thermophysical parameters, with functional forms determined from terrestrial and earth-based lunar results, and, especially, an extensive study of the Apollo lunar results. In addition, the effect of surface roughness on the observed brightness temperatures was analyzed. Discussions are presented of how imposing the double cosine form on the observations affected the value of the derived mean disk brightness temperature, the significance of the thermal inertia and possible systematic difficulties in the investigation. Dissert. Abstr.

N78-20040 Yale Univ., New Haven, Conn.
THE COSMOCHEMICAL HISTORY OF THE PALLASITES Ph.D. Thesis
Andrew Morgan Davis 1977 298 p
Avail: Univ. Microfilms Order No. 77-27808

The pallasites are a relatively rare type of meteorite containing approximately equal amounts of olivine and iron-nickel with minor amounts of troilite, schreibersite and chromite. A systematic study of the trace element abundances of the pallasites was undertaken with the goal of determining which chemical fractionation processes have affected pallasite compositions. The pallasites were classified on the basis of their chemical compositions. Dissert. Abstr.

N78-20041*# Colorado Univ., Boulder. Lab. for Atmospheric and Space Physics.
SOLAR HEATING IN THE MARS DUSTY ATMOSPHERE
Richard W. Zurek 20 Jul. 1976 61 p refs
(Contract NAS5-22440)
(NASA-CR-156696) Avail: NTIS HC A04/MF A01 CSCL 03B

The complex refractive index in the solar spectral region is estimated. With this index and the size distribution estimated from the UVS data Mie theory is used to compute the radiative parameters required for including radiative scattering in simplified radiative transfer approximations. These approximations then enable the wavelength-integrated solar heating to be computed for various dust-laden Martian atmospheres. The calculations presented in the main body of the paper were computer using the delta-Eddington approximation. Author

N78-20042*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIKING LANDER IMAGING INVESTIGATION: PICTURE CATALOG OF PRIMARY MISSION EXPERIMENT DATA RECORD
Robert B. Tucker (Stanford Univ. Med. Center, Calif.) Feb. 1978 514 p refs
(NASA-RP-1007; L-11752) Avail: NTIS HC A22/MF A01 CSCL 03B

All the images returned by the two Viking Landers during the primary phase of the Viking Mission are presented. Listings of supplemental information which described the conditions under which the images were acquired are included together with skyline drawings which show where the images are positioned in the field of view of the cameras. Subsets of the images are listed in a variety of sequences to aid in locating images of interest. The format and organization of the digital magnetic tape storage of the images are described. The mission and the camera system are briefly described. Author

N78-20043# Los Alamos Scientific Lab., N. Mex.
COMPUTER-GENERATED MAPS OF LUNAR COMPOSITION FROM GAMMA RAY DATA
J. R. Arnold, A. E. Metzger, and R. C. Reedy 1977 9 p refs Presented at the Lunar Sci. Conf., Houston, Tex., 14 Mar. 1977
(Contract W-7405-eng-36)
(LA-UR-77-1487; Conf-770322-5) Avail: NTIS HC A02/MF A01

Old results were confirmed and new information obtained, especially with respect to the distribution of Fe over the area mapped, and the correlation of Fe with the radioactive elements. The results are displayed. ERA

N78-20044# Los Alamos Scientific Lab., N. Mex.
GLOBAL SEISMIC EFFECTS OF BASIN-FORMING IMPACTS
H. G. Hughes, F. N. App, and T. R. McGetchin 1977 43 p refs Presented at Conf. on Comparisons of Mercury and the Moon, Houston, Tex., Nov. 1976
(Contract W-7405-eng-36)
(LA-UR-77-368; Conf-761165-1) Avail: NTIS HC A03/MF A01

The effects of large impacts on planetary surfaces were investigated using a Lagrangian computer program which treats shock wave propagation and includes the effects of material strength, elastic-plastic behavior and material failure. The global seismic effects for cratering energies intermediate between the Copernicus and Imbrium events on the moon, are studied and the phenomenologies for assumed solid and molten planetary interiors are compared. The principal results are as follows: (1) Far-field effects are largely independent of cratering mechanisms. (2) Antipodal seismic effects are significantly enhanced by focusing and are of substantial magnitude. (3) The most violent activity occurs at significant depth beneath the antipode, considerably after the passage of the initial compressive/rarefactive shock wave, and results from complex interactions with the free surface. (4) Seismic effects are more pronounced for a molten planet than for a solid one. (5) Tensile failure may occur at depths of tens of kilometers beneath the antipode, and may also occur over the entire surface, although at shallower depths. ERA

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N78-20045*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ROLE OF O-TYPE NEUTRAL LINES IN MAGNETIC MERGING DURING SUBSTORMS AND SOLAR FLARES
David P. Stern Feb. 1978 49 p refs Submitted for publication
(NASA-TM-78093) Avail: NTIS HC A03/MF A01 CSCL 03B

An analytical model of O-type configurations was derived, for visualizing the geometry and for numerical treatment of plasma flows. It was found that at a certain distance from the neutral line the mean particle motion became decoupled from that of magnetic field lines (which obey the MHD condition). The decoupling distance depended on initial conditions in momentum space, suggesting that the MHD approximation which averages out such conditions may not suffice for describing plasma dynamics near the neutral line. It was also found that after inflowing particles are decoupled from the field line motion, they go over to a mode of runaway acceleration along the neutral line. It is concluded that if merging occurs at an X-O pair, two particle populations may be expected - low energy particles accelerated adiabatically by earthward convection past the X-type line and high-energy particles convected towards the O-type line. The second acceleration process depends critically on the rapidity of merging and is therefore expected to vary considerably from event to event. Author

N78-20046*# Stanford Univ., Calif. Inst. for Plasma Research.
STOCHASTIC ACCELERATION OF SOLAR FLARE PROTONS
D. D. Barbosa Mar. 1978 35 p refs
(Grant NGL-05-020-272; Contract N00014-75-C-0673)
(Su-SUIPR-739) Avail: NTIS HC A03/MF A01 CSCL 03B

The acceleration of solar flare protons is considered by cyclotron damping of intense Alfven wave turbulence in a magnetic trap. The energy diffusion coefficient is computed for a near-isotropic distribution of super-Alfvenic protons and a steady-state solution for the particle spectrum is found for both transit-time and diffusive losses out of the ends of the trap. The acceleration time to a characteristic energy approximately 20 Mev/nucl can be as short as 10 sec. On the basis of phenomenological arguments an omega/2 frequency dependence for the Alfven wave spectrum is inferred. The correlation time of the turbulence lies in the range .0005 less than tau/corr less than .05s. Author

N78-20047# Los Alamos Scientific Lab., N. Mex.
SOLAR PROTON FLUXES SINCE 1956
R. C. Reedy 13 Apr. 1977 28 p Presented at Lunar Sci. Conf., Houston, Tex., 14 Mar. 1977
(Contract W-7405-eng-36)
(LA-UR-77-909; Conf-770322) Avail: NTIS HC A03/MF A01

The fluxes of protons emitted during solar flares since 1956 were evaluated. The depth-versus-activity profiles of Co-56 in several lunar rocks are consistent with the solar-proton fluxes detected by experiments on several satellites. Only about 20% of the solar-proton-induced activities of Na-22 and FE-55 in lunar rocks from early Apollo missions were produced by protons emitted form the sun during solar cycle 20 (1965-1975). The depth-versus-activity data for these radionuclides in several lunar rocks were used to determine the fluxes of protons during solar cycle 19 (1954-1964). The average proton fluxes for cycle 19 are about five times those for both the last million years and for cycle 20. These solar-proton flux variations correlate with changes in sunspot activity. ERA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N78-20048# Energy Research and Development Administration, New York. Health and Safety Lab.
MEASUREMENTS OF COSMIC-RAY CHARGED PARTICLE IONIZATION AND FLUX DENSITIES IN THE ATMOSPHERE
Wayne M. Lowder, Harold L. Beck, and Peter D. Raft Jul. 1977 15 p refs
(HASL-324) Avail: NTIS HC A02/MF A01

The results of ionization rate and flux density measurements of cosmic-ray charged particles with balloon-borne, high-pressure argon ionization chambers and counters are presented for flights from Cape Girardeau, Missouri, in September 1972 and from Fort Churchill, Manitoba, in July 1973. Ionization rate data from Health and Safety Laboratory equipment are compared with measurements made on the same flights with a standard argon chamber which has been used for many decades to obtain profiles of cosmic-ray ionization rates in the atmosphere. It is tentatively concluded from these comparisons and other evidence that the latter measurements overestimate the ionization rates by about 10%. ERA

99 GENERAL

No abstracts in this category.

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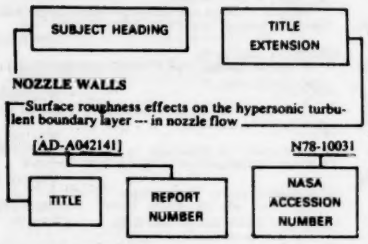

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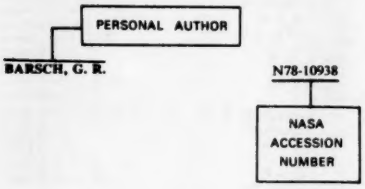

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CURRY, R. E. N78-19170
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DANIEL, M. R.
DAVIS, A. M.
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DAVIS, C. G., JR.
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DEAL, B.
DECELL, H. P., JR.
DECKER, A. J.
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DEGRAAF, J. G. A.
DEIS, D. W.
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DEWITT, H. K.
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DIMMLER, D. G.
DINERMAN, C. E.
DIPASQUA, A.
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HUKE, R. E.
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HULSTROM, R. L.
HUSBAND, J. D. W.
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ILES, J. E.
ILIFFE, J. K.
INGLE, A.
INGRAM, J. C.
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IQBAL, M. Z.

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JACKSON, J.
JACKSON, J. L.
JAIN, A.
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JAKOB, H.
JAMES, M. R.
JANETZKE, D. C.
JANOCKO, M. A.
JANSER, G. R.
JARDIN, S. C.
JARZEBINSKI, L.
JEANMAIRE, D. L.
JENKINS, J. L., JR.
JENNINGS, D. E.
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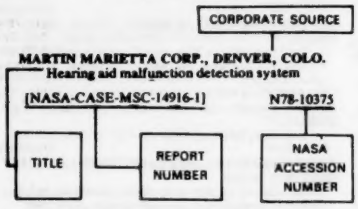

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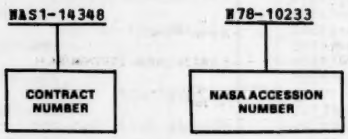

Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

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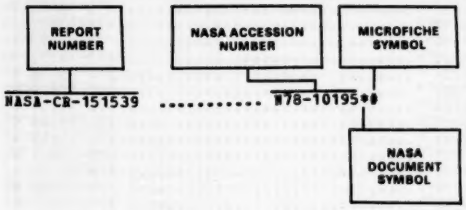

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